The Welding Engineer

Edited by L. B. Mackenzie

$3.00 per year in U. S. | Reg. U. S. Pat. Office | $4.00 per year abroad

Vol. 8 | 608 S. Dearborn St. | AUGUST, 1923 | Chicago, Ill. | No. 8

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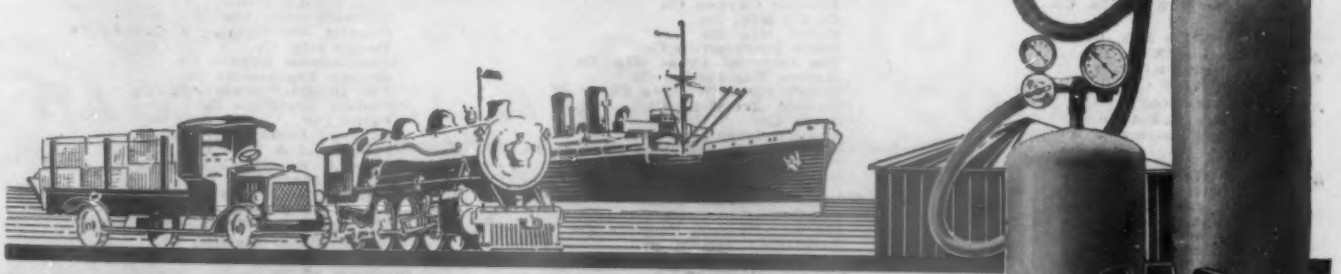

WELDING PUROX CUTTING

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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For Welding High Carbon Steel

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Conform in all respects to A. W. S. specifications. E—No. 1-C.

Look for red tag and red-colored ends.

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(Scleroscope)

1	(Original Metal)	30
2		34
3		33
4		35
5		37
6		38

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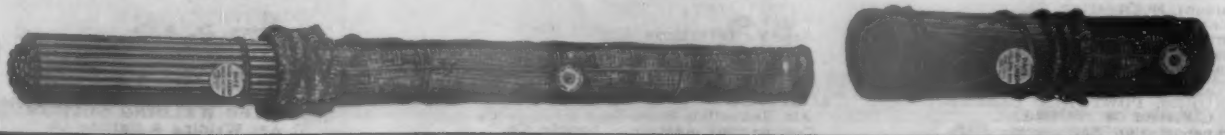

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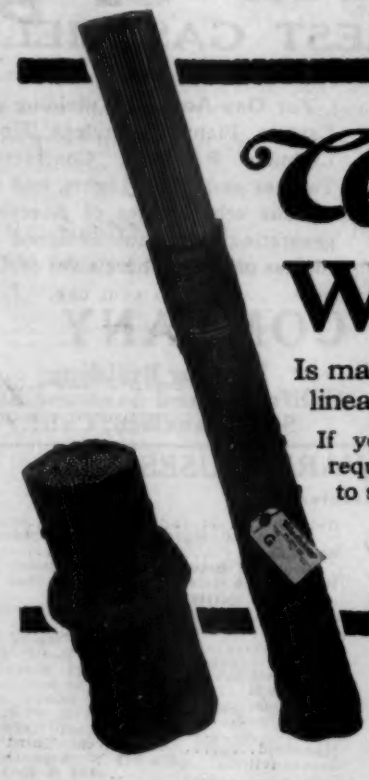

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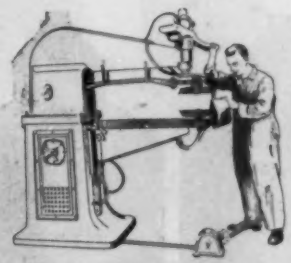

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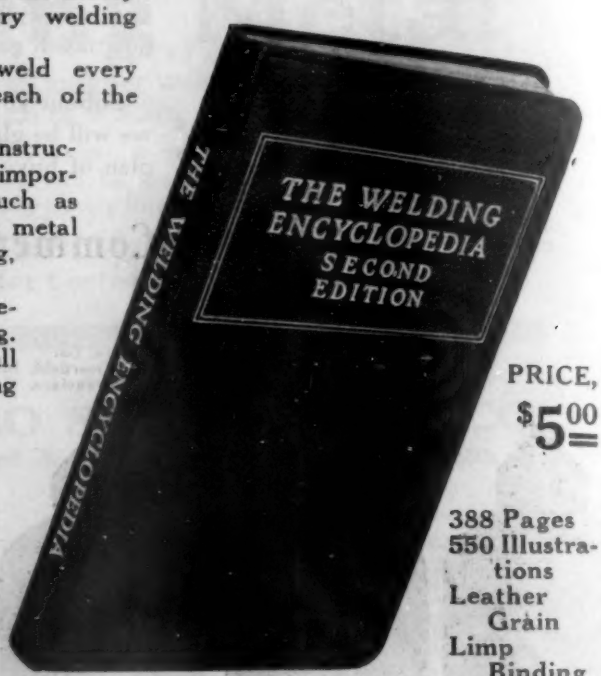

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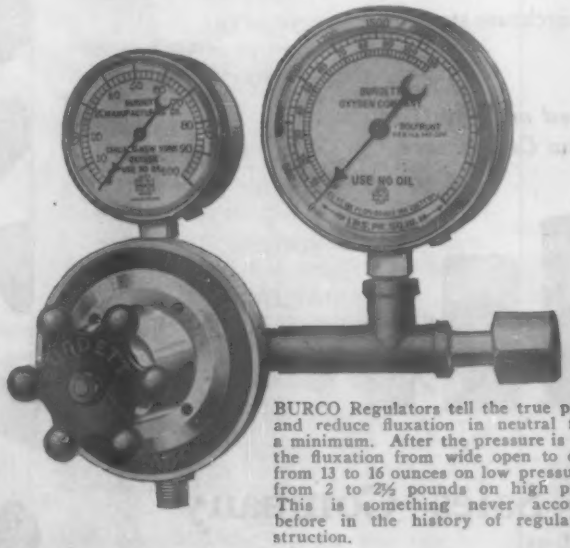

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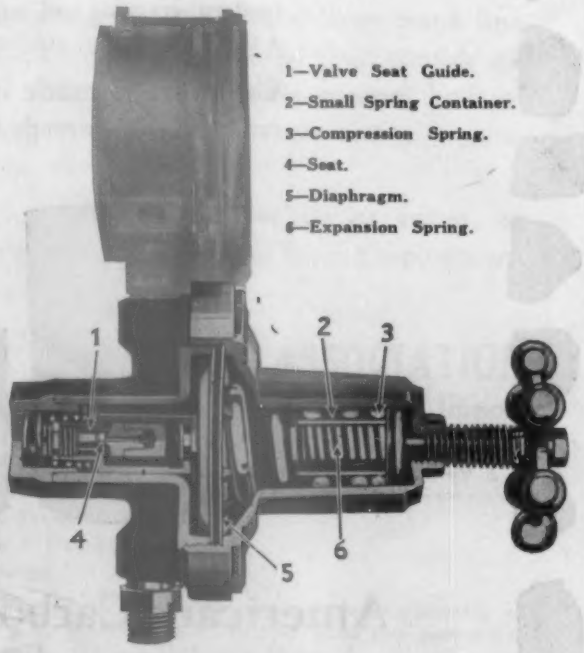

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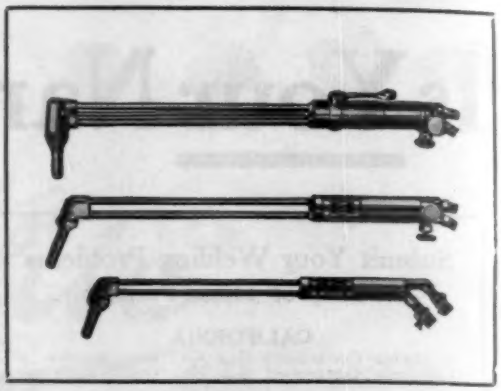

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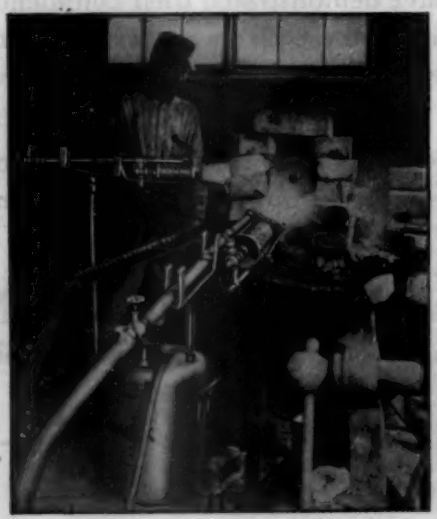

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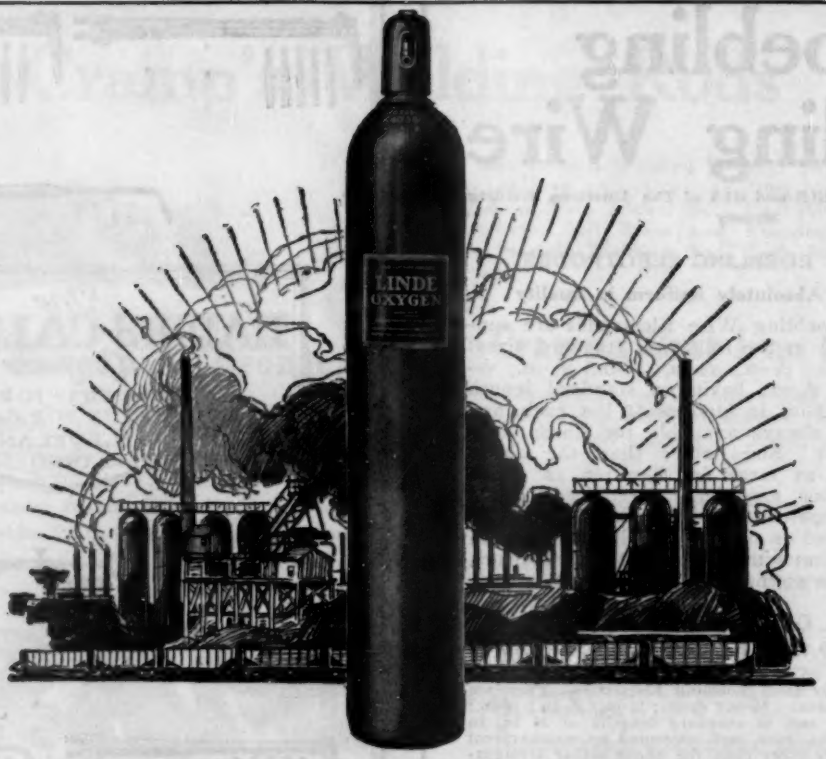

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LINDE OXYGEN

FLANGE WELDED TANKS

New Type of Construction Cuts Down Loss of Oil Through Leakage—Flange Joint Adds Strength

MESSRS. Mangrum and Toevs, of Los Angeles, have invented and developed an interesting method of constructing oxy-acetylene welded small storage tanks. All plates entering into the construction of the tanks are flanged and welded. This method of construction not only greatly strengthens the tanks but likewise permits the insertion, in the larger size tanks, in the upright joints, of a piece of "T" beam to give further rigidity to the walls. Aside from this some strong points in favor of this construction are: the rapidity with which the tank could be set up and also its salvage value, inasmuch as the welded flanges can be cut back with a cutting torch and the tank moved to a new location and again set up by merely welding the flanges along the edges where cut.

Flanges Increase the Strength of the Seam.

The Flange Welded One Piece Tank has been thoroughly planned out after many years of actual experience on other types of storage tanks, and has placed the inventors in a logical position to know the weak points of other tanks, loss of time to oil operators and heavy financial waste through leakage. Such leakage at present reaches into an enormous sum of money each year. As a fair estimate, yearly leakage loss is 5 per cent on medium oil, with higher percentage on light oils and less on heavy oil. The Flange Weld overcomes all this, as the flange is turned out and always exposed to view as well, making it accessible for repairing, if such should be the case, after testing tanks. The open seam on the inside of tanks, with re-inforcing straps on the round seam and tee irons being inserted between the flanges on the straight seams and spot welded 8 inches apart on the inside flanges, making a free allowance for expansion and contraction caused by temperature changes. The filling and emptying of tanks, together with settling of the foundation on account of the great weight, are the cause in most instances of leaks in bolted and rivited tanks. Unlike the Flange Weld, with its reinforcement straps, has all the stiffness necessary for strength without losing the flexible advantages, making a tank 15 to 25 per cent stronger than bolted or riveted tanks, heavy black sheet steel being used. When considered from a salvage standpoint, the Flange Welded tanks, has another great feature, the welding edge of Flanges is cut off with cutting torch with amazing speed, and on the inside the reinforcement straps are cut in the center. The sheets are marked and shipped to new location and ready for rebuilding. Large tanks can be readily moved short distances on trucks without being cut apart, as its great strength will allow for handling to that extent, as there is no solder to crack, gaskets or bolts to tear loose. The flange Weld Tank is one piece of metal in every phase of its construction.

The main feature and requirements of storage tanks are; Speed in Erection, Strength, Leak and Vapor Proof, together with its Salvage Value. Welding is acknowledged by experts to be far more rapid than bolted work on tank construction. On the bolted tank, the sections are connected together with bolts and rubber gaskets. Cement and asbestos wicking with final application of leak proof dope, light channel iron being used punched to fit and bolt holes. The bolts are then thrust thru and tightened on the outside, the head is drawn tight into the Channel iron and prevents turning co-operating to make a tight job. With thousands of holes and seams held together in this manner, it is impractical and a makeshift construction. The bottom is very often a serious proposition. Tunneling underneath or lifting the entire tank to get at bolts with stripped threads.

The flange welded tank with outstanding flanges are equivalent to angle irons around each sheet and then welded at the outer edges with heavy strap reinforcement across the seams on the inside and securely welded, thereby doubling the strength of every seam.

Repairs Can Be Made from Outside of Tank.

Repairing if necessary is easily accessible, as all the flanges are formed on the outside of the tank, with the exception of the bottom which is flanged upward and welded strap reinforcement across seam. The roof being laid out at the same time and manner as the bottom, with the exception of the flanges being on the outside and reinforced on the inside, with angle iron supports and center pole. The edges being welded at all seams. The outer edges being welded to the flanged edge of the top ring completely around the tank. A dog house man hole near the bottom and a man hole for the top on the roof being the only bolts in the tank, together with fire proof gaskets.

Standard Roof

The roof being laid out at the same time and manner as the bottom, with welded flanges on the outside, with suitable angle iron for additional support and center pole of steel pipe, with flat steel plate on top. The center pole is forced upwards with jacks, and the sag taken out, affording sufficient drainage and stiffness.

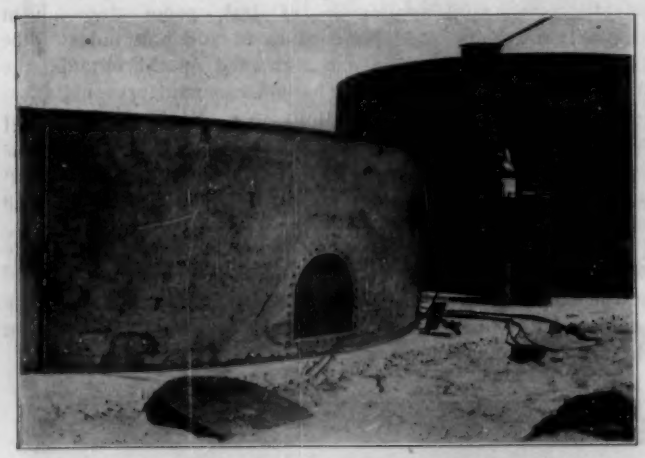
Roofing, Water Seal.

Water seal roof is laid out at the same time, size and manner as the bottom, with one exception. One gauge lighter material is used. The water seal is flange welded at its edges and supported in the center with four four-inch pipe for center poles on large tanks. Welded to the bottom and joined together with heavy angle irons at top. And then run out to the edges of tank and welded. The roof is placed on the supports in sections and welded together at flanges through centers. A flange is turned on shell, roof extended out and welded, the same as bottom and first ring. The water seal ring is placed with a depth of 6 or 8 inches, as per order and welded at its flanges.

Specification and Construction of Flange Welded Tank.

Bottom of Tank.

Black sheet steel, with upturned flanges, spaced and clamped together for expansion and welded, the bottom



Showing Neatness and Strength of Welded Tank.

being one inch larger to allow for flange welding on the first ring of the tanks.

First Ring.

Black sheet steel flanged on all four sides, formed to a horizontal contour, with flanges to fit perfectly, as each sheet is welded together, with the tee iron reinforcement. After making complete circle of tank, all the sheets are welded together by their end flanges. They are then tack welded to the outside edge of tank bottom. It is then welded or completed on the outside. The reinforcement angle irons, four inches long, then welded about thirty inches apart to the bottom of ring and the bottom of the tank.

Second Ring.

A light gin pole is then placed in the center of the tank, and sheets hoisted to position and welded; the reinforcement straps are placed and welded on the sheet and finished, when it is joined to the tank. As much work as possible is finished on the floor of the tank before being raised to its position, as scaffold work requires more time. The third and fourth ring are a repetition of the second ring, being raised to position with gin pole tacked in place and finished.

Comparison of Tank Construction.

Operations Required in Building Bolted, Riveted and the Flange Welded Tanks.

Bolted Tanks.

Laying out.
Punching bolt holes.
Rolling channel irons.
Cutting channel irons—SIX OPERATIONS.
Punching channel irons.
Cutting gaskets.
Cementing surface for gaskets.
Placing gaskets.
Placing channel irons.
Punching holes through gaskets—SIX OPERATIONS.
Bolting space.
Bolting.

Corrugated Tanks.

Operations.

Dog house made.—FOUR OPERATIONS.
Punching iron in the flat.
Corrugated iron.
Rolling iron to form.—EIGHT OPERATIONS.
Bottom set up on horses and dog house riveted bottom and lower to platform.
Turning vertical flanges for bottom ring.
Tacking up.
Riveting.
Soldering.

Flange Welded Tank.

Shop.

Laying out. TWO
Flanging and forming one operation. OPERATIONS

Field.

Tacking up. TWO
Welding. OPERATIONS

In a letter to W. C. Marston, manager of the Purox Company of Los Angeles, Mr. Mangrum said:

"The two 260 barrel tanks just completed were given a water test without a leak or breakage. The welding equipment and gas you supplied for use on the job contributed to the speed and efficiency of the construction work with the result that the tanks were constructed so rapidly as to cause considerable surprise to the inventors and others interested in getting better equipment for oil producers. These tanks are leak proof, fire proof, vapor proof and at the same time have a salvage value far beyond that of similar sized tanks constructed by any other method. The photographs give a good idea of the neatness and strength of the tanks afforded by the welding flanged edges that serve as an actual angle iron around each sheet of metal."

FLAME CUTTING ON A RADIAL DRILLING MACHINE

The Galigher Machinery Co., Salt Lake City, Utah, is an extensive user of oxyacetylene for cutting and welding. Some time ago it became necessary to cut a number of rings from boiler plate steel, and it was decided to enlist the services of a radial drilling machine for this purpose. A suitable table was constructed, mostly of steel angles, as shown in the accompanying illustration.

The sheets to be cut were laid on this table. The bar carrying the crossarm was placed in the spindle of the machine and the cutting torch clamped at the outer end of the crossarm. The center was brought into position over the punch mark in the plate and the torch set at the proper radius to give the desired circles.

When properly adjusted, the spindle of the radial drill was revolved by hand at the desired speed, and the circles were quickly obtained. This method has the advantage of giving almost any radius desired, and of changing rapidly from one size to another.—*American Machinist.*

ARC WELDING CAST IRON*

Various Methods of Making Arc Welds on Castings Without Studding—Use of Carbon Arc

By C. J. Holslag†

WHEN modern electric arc welding methods successfully overcome the difficulties of welding cast iron, a great field of usefulness was at once thrown open for the benefit of those who used this common and yet peculiar metal in their machines or processes. The properties of cast iron are those of brittleness and low tensile strength, making it liable to strains or cracks under the stresses of sudden heating or cooling, or to fracture under too heavy mechanical strain. In spite of these shortcomings, the cheapness and ease with which it may be produced have made the metal useful in an infinite number of ways, with the consequence that the field for iron welding is enormous and is constantly broadening.

Although the greatest use for this type of welding is at present found in repair work, developments have taken place so rapidly that they have outstripped actual practice in the majority of welding shops, and there is really no good reason why cast iron welding should not be employed for many other operations than those of repair work, such as the construction of various machine parts and structures. It is to be hoped that those interested in the future of welding everywhere will give these methods of cast iron welding a thorough trial, for thus they will not only realize its possibilities, but will, by their own experience, do much to improve it.

However, if cast iron welding were confined to repair work alone, there would be a multitude of outlets for its usefulness in this field. At the very place where the castings are produced in the foundry, the process at once becomes of great assistance in the repairing of defects, filling blow-holes, sand-holes and other flaws, and, in short, restoring and renewing castings that would otherwise be a total loss. Then, when these castings are made into machine parts, many defects which were previously unnoticed are liable to develop under the stress and scrutiny of machining. Here again the electric process comes to the fore, building up parts that have been wrongly machined down, filling uncovered blow-holes and defects, and saving time, money and difficulty generally. It will be seen, too, that this holds true after the casting has been incorporated into some machine for if it should then crack or fail, it may, in nine cases out of ten, be welded on the spot, without dismantling the machine or seriously hampering the production. This will save the delay and expense involved in scrapping the broken casting and sending it to the factory for a new one. There are also a goodly number of castings that if broken in shipment are cheaper welded than returned for replacement.

The majority of the castings with which the electric arc welder will have to deal will be of gray iron. The iron of these castings is usually made so that it will be soft enough to machine, and yet tough enough to stand a reasonable degree of strain. A cast iron rod a foot long will expand an eighth of an inch in length when heated white hot, and it is this large coefficient expansion that makes it necessary that the unequal application of the great heat required for welding be minimized or compensated for. If two pieces of cast iron are to be welded together, the iron must be melted at the point where the weld is made. At the same time, this melting is only local and the molten weld will cool very quickly after the source of heat is removed because of the absorption of its heat by the larger mass of the surrounding cool iron. In thus quickly cooling, the cementite which has been formed in the molten mass is not given a chance to break up into graphite and iron, and the result is apt to be a hard, unworkable weld, especially in that part of the weld nearest the parent metal. Besides this, the silicon and manganese are the first to burn out, leaving whatever sulphur there is present to aid in producing a hard weld. Sometimes an excess of silicon and manganese is introduced into the weld by means of a separate flux, or a flux coating on the electrode. Molten iron in contact with air will oxidize rapidly, hence the surface of a weld is apt to become coated with a film of oxide which, if included later in the weld, will weaken it. This is obviated by the use of a special flux, and by making the weld continuous in a given locality.

If a filler metal of different composition than that of the parent metal is to be deposited, the difference between the rates of shrinkage of the two must be taken into account. For, if the parent metal shrinks faster than the metal of the weld, the two are apt to become separate, so that one slides over the other, and the purpose of the weld is thus destroyed. Or, if the weld itself does hold, the brittle cast iron about the weld is liable to crack as a result of the internal strains that have been set up. This may be prevented by proper preheating, by the use of certain kinds of electrodes, by adding a chemical flux which will tend to keep the weld free of hard carbon compounds, or by proper studding.

At any rate, the operator must be prepared to meet the following characteristics in the average cast iron welding job: low tensile strength combined with absolutely no deformation or bending, an average content of carbon of about 3 to 12 per cent (which will tend to harden the weld under heat), large coefficient of expansion, and tendency to form the products of oxidation (slag and dross). All these properties, chemical and physical, must be overcome before a successful weld can be made, and hence they are of great importance to the operator. He may easily take steps to overcome these difficulties, however, if he thoroughly understands their causes.

So that a perfect start may be made, it is very important in cast iron work especially to make thorough preparation before welding. Wherever the weld is to start, a clean metallic surface should be presented, so that a good contract for striking the arc may be established, and so that no foreign matter may be included in the weld. All blowholes and the like which are to be filled should be scraped or chipped clean and cracks and imperfections should be veed out as in previous instructions. There are, however, additional methods of procedure which are peculiar to cast iron welding practice. It must be remembered that the surface of an iron casting will usually be harder than the inside, because, in founding, the iron cools quickly at the surface, and more and more slowly towards the middle. Since the harder portion is easier to weld, it sometimes suffices, in closing a crack, to clean the metal about it, thoroughly and to weld from the surface upward, using the cross-lacing method. If, in this case, strength is desired, it will be necessary to add a rather thick bead pad, which, of course, is a drawback in many cases. The operator, however, should bear the foregoing facts in mind, and should not, unless he intends to make use of the studding process, chip out too deep a "V." This is particularly the case in cast iron work because of the usual noticeable difference between the rates of expansion of the cast iron and of most filler metals.

If the job is of a size and accessibility that will allow of the

*Extract from Instruction Handbook of Electric Arc Cutting and Welding Company.

†Electrical Engineer, Electric Arc Cutting and Welding Company.

process, it is always good practice to preheat the entire casting before the weld has started, because if the entire mass is hot the weld itself cannot cool so quickly, and hence cannot harden into carbon compounds. Moreover, it will be understood, that, in order to weld, the metal under the electrode must melt, and therefore, welding cannot take place until the temperature of the metal has already been raised to some extent by preheating, less heat at the arc may be used to produce fusion, and, consequently, a lower current tap may be used. Also keep in mind that where preheating is feasible, the electric arc process does not differ from gas in the results to be obtained. In other words, the sudden and concentrated heat of the arc will not, in this case, have to be applied so long, and hence there will be less danger of unequal heat strains. This theory should be remembered when preheating is to be applied. Thus preheating is desirable where the piece is of such peculiar shape that the application of the welding heat would inevitably result in the strain of expansion or contraction being thrown upon a very weak part of the structure. In this type of preheating, it is seldom necessary to heat the piece unduly, since the object is only to distribute the strains more evenly. A uniform application of heat with the gas or oil torch, or with the preheating carbon arc handle is all that is necessary, or by a coal, charcoal or even a wood fire.

Experience alone can show the operator the conditions which demand the preheating of a piece, together with the quantity of heat to apply. Sometimes a job may be made perfect by annealing only, which means that the piece, after having been welded cold, is heated and cooled slowly. If the occasion demands, a wall of brick or other refractory material may be built around the piece, and the heat applied by means of a slow charcoal or coke fire. This method, however, is tedious and seldom necessary, as the application of heat uniformly with the torch will usually fill all preheating requirements. It is well, however, whether the piece has been preheated or not, to shield it from all drafts and sudden coolings while welding. With proper attention to strain distribution and uniform heat application a little at a time, a great many cast iron welding jobs that would formerly have been preheated, are now being done cold, that is, without preheating. In fact, many experienced operators will do the work in no other way, because they assert that results are quite as good.

There is another method of welding which employs the same principles that make studding possible, and which should be touched upon here for the sake of completeness. It is especially useful on sections that are too thin for studding, as automobile cylinders and jackets, crank cases and heating boilers, together with parts so complicated in shape that they will tolerate no deformation. In this process, lines of beads are run at right angles to the crack. In addition, other bead links are laid down at right angles to these, and are laced back and forth at distances of four to six times the thickness of the piece. This prevents the weld from separating, as well as compelling the contraction to take place in the weld, which is perfectly capable of withstanding the strain. This constricting action is usually sufficient to bring two edges of a crack into such intimate contact that it is perfectly sealed. In this manner all kinds of thin sections in cast iron may be rapidly and successfully welded. Automobile water jackets have, in an emergency, been welded without taking the water from the engine. Sometimes, in quick work, the weld will be stressed beyond its elastic limit and crack, but in rewelding this crack will be permanently sealed.

Naturally, the less heat used in this process, the less care will the operator have to use in taking precautions toward preventing stress. Accordingly, he should use the light work taps of the welding machine to secure the minimum quantity of heat necessary to weld. He should proceed by welding a little at a time, allowing one bead to cool completely before starting on the next one. It is, however, necessary to make an exception to this rule in the case of the contracting bead links mentioned in the previous paragraph; these should be laid down, each as quickly as possible in order that the contracting effect may be uniform in the individual link.

In order to keep the heat value as low as possible, a special electrode, with a melting rate higher than that of ordinary steel, should be used. The operator will find this of material assistance in eliminating the stresses. When working on scored cylinders, if the machine can be set so that it will just draw an arc, but not sustain it, the metal may be deposited in one flash at a time, and without cracking the cast iron, by the use of the special nickel electrode. Where the machine cannot be set at half voltage, a spring foot switch in the primary or secondary circuit may be provided. This may be opened by the operator immediately after each drop is deposited, by the action of the foot, thus providing a means of cutting off the current, so as not to use it continuously at the high temperature of the arc. If a nickel electrode is used, the weld must be caulked in place, but the special electrode of nickel, manganese and copper may be run continuously, providing the cast iron wall is thick enough to take up the heat strains. With these nickel electrode processes the weld and cast iron is machineable. All of this welding is done without preheating or annealing of any kind, and where the necessary finish on this light work can be produced by grinding. Many operators, through continued experience on cast iron of thin sections, become so proficient that they are able to perform the majority of cast iron work that comes to them in a welding shop without studding, preheating, or annealing of any kind. This ability, however, is based on a thorough knowledge and experience in all these methods.

There are some cases where the studding process is not at all necessary. A little care on the operator's part will suffice to produce excellent results. Examples of four generic types are given, and, although these do not entirely cover the field, the operator will, by their aid, be able to recognize those types of cast iron weld which may be safely performed without special preparation.

Studding is never required where proper preheating is feasible. The non-studded weld serves a wide field of usefulness in the reclaiming and repairing of castings that have either developed flaws in founding, or have been incorrectly drilled or machined. Studding is not required where the weld is to serve simply as a means of filling-in or building out, and where grinding is the only machining necessary. The spot to be welded should be cleaned out by chipping or grinding so that all dirty, oily, sandy or oxidized metal is cleared away, and a reasonably bright metal surface is provided for the foundation of the weld. Either a steel or cast iron electrode may be used, according to the hardness of the surface desired. The steel gives a fairly hard surface, and the cast iron a very hard one. In using the cast iron electrode, care must be taken that the quick cooling does not imprison gas bubbles in the weld, which show up as holes after the work is machined. No such trouble is attendant upon the use of the fluxed steel electrode, although if slight imperfections should develop, peening will close them up.

A second general case in which studding may safely be dispensed with is found in the completion of welds in which tensile strength is required, with but little resistance to bursting pressure, that is, to an expanding stress like that brought to bear upon the walls of tanks or containers. Work of this type is found on various broken machine parts, small bed-plates and the like; on short pieces in which no undue strain will be encountered; and where the section was broken by some accident which will hardly occur in the same place again. The procedure is to vee out the break to an angle wide enough to allow the electrode to be held perpendicular to either face of the "V". The two faces are then separately covered with a layer of steel, the operator taking great care to unite the steel to the cast iron as the arc progresses, and not to let any of the molten metal run down ahead of the puddle. The weld should be made from the bottom up, and if any of the deposited metal does run away, the operator should stop and chip it off. After

the two faces of the "V" are covered, it is comparatively easy to build up the rest of the weld from the two steel pads, by the use either of the steel or cast iron electrode. The cast iron electrode is only successfully used when pieces are hot. In cast iron welding flux covering of electrodes often spells the difference between success and failure.

Cast iron may also be welded by the use of the carbon arc, either single or double, which latter is an arc drawn between two carbon or graphite electrodes held in a special holder. The filler metal is added by means of a separate filler rod, melting into the parent metal already made fluid by the carbon arc. The carbon arc is really a source of external heat, and spreads the heat far more than the concentrated spot provided by the metallic arc. The use of the separate filler rod complicates matters, as well as the need for the use of a separate flux, which is best supplied on the rod itself and which is usually some sort of carbonate which will form gaseous oxides and prevent the forming of slag or dross. Because of the heat distribution, this type of welding is difficult on thin work, and practically impossible on vertical and overhead work, for the reason that large amount of heat applied causes the metal to melt rapidly and run away unless confined. It is urged that, with the carbon arc process, a cast iron filler rod may be used which will resupply welded metal to the piece of the same kind as the base metal, but the development of the modern cast iron electrode has made this possible where the direct electrode-to-work method is used. However, various types of carbon and graphite rods have been developed for use if the carbon arc, but its function is chiefly confined in cast iron work to preheating and annealing methods.

Brazing is also possible by means of this carbon arc and special handle, but, since the process is not properly related to any branch of electric welding, it will not be treated here. The enormous heat and penetrating qualities, together with the general efficiency of the electric arc, has little in common with a method requiring no more heat than is furnished by a soldering torch. As a matter of fact, the welding process should take the place of brazing as a modern and more efficient substitute for accomplishing and improving the results, and superseding the old-fashioned one, which is little better than soldering.

The uncoated steel electrode is seldom used in cast iron work, because of its great tendency to deposit a weld which will separate from the cast iron, according to the reactions above described. The molten steel from this electrode, contains no material in the form of a flux which will assist in decarbonizing the iron, produces a weld that is apt to be very brittle where the steel joins the cast iron. This weak line of demarcation which is inevitable when plain steel electrodes are used without studding, is often too weak to hold the steel and cast iron together as they contract.

The use of the flux-coated steel electrode does much to improve these conditions. Various fluxes are used, composed mostly of compounds which either unite with the carbon in the cast iron, or tend to keep the hard carbon-iron compounds from forming. The favorable effect of these various chemicals has already been discussed. The coatings usually consist of some compound rich in carbon, such as lime or other carbonate, which, under the heat of the arc, resupplies the free carbon which may otherwise be burned out, and which tends to keep the weld soft. In addition to this, the flux often contains silicon, manganese and other chemicals which either prevent oxidation, tend to keep the weld molten, or bring about other desirable results. The flux-coated steel electrode may be used in all studding work, and other work of a kind that does not have to meet special requirements. A very efficient electrode has been developed for this purpose, and is of mild steel with a heavy carbon coating, so that the carbon burned out by the arc is restored.

The use of a cast iron electrode coated with a special flux which resupplies the burnt-out compounds, producing actual cast iron in the weld itself, is an essentially modern development. This electrode is thoroughly practical, though, of course, it cannot be used without the flux coating except as a filler rod in the carbon arc process outlined above. The special flux, however, provides a remedy for several difficulties which would make the use of the uncoated electrode impracticable. The most important purposes for which this cast iron electrode has provided are:

1. A quieting reagent.
2. Rapid floating of dross to the surface.
3. An absorbing of oxygen and nitrogen, so that bubbles, films or needles of oxide are not left in the weld.
4. A protection against rapid surface cooling.

This makes it possible to produce a weld with the fluxed iron electrode which possess all the properties of the original cast iron, besides being capable of being deposited without any special preparation, and with no more than the usual care required in ordinary welding. This electrode may be used wherever a welded section is wanted that will equal the properties of the parent metal, and in many cases in place of the steel electrodes.

In addition to these three types of electrodes, there are those made of special alloys, which are very efficient for certain kinds of work. In general, these alloys have the property of not only merging well with the cast iron, but of producing a soft, easily machinable weld. Moreover, they may be deposited cold, that is, without preheating or similar preparations. They are usually melted easily, and hence may be deposited with the use of less heat than that required by the steel or iron weld. This is an index to their use. They are variously made of Monel metal, nickel, copper-nickel and other similar and soft metals. As these special metals are usually expensive, they are largely used only for filling shallow cracks or scores, or to provide a machinable surface on a steel or iron weld. In the latter role they are most efficient, providing a weld with a nicely machinable surface, and having a strong steel body. Of course, it is understood that any of these special alloy electrodes may have flux coating, and that the proper type of flux will add to their efficiency. As a matter of fact, any metallic electrode may be advantageously used with a flux coating of the proper kind.

As to the general use of current values in cast iron welding, it is always best to remember that the smaller the amount of heat applied the less danger there is of the cracking or warping to which cast iron is a peculiar prey. It has already been remarked that the greater the current the greater the heat. To cut this down, therefore, a combination of electrode and machine setting should be preferred which will supply only the heat necessary to provide good penetration and fusion. Of course, the operator cannot be expected to judge this minimum value accurately at first, but experience will soon give him confidence.

There remains but to speak of the after-treatment of the welded cast iron, often used to produce softness, and to change the physical properties of the weld. This process is known as annealing, and its use will remove the hard layer between a steel weld and the cast iron which has already been referred to. It will also destroy the hard carbon compounds in the entire weld and make it soft and machinable. The process is nothing more than a slow cooling down of the weld from little more than red heat, causing the graphite to remain uncombined. A torch or preheating arc may be applied to bring the weld and adjacent parts up to slightly better than red heat, allowing it to remain at this point from two to ten minutes, depending on the size of the piece. It is then cooled slowly by burying it in warm sand, fireclay or limestone, or it may be cooled by surrounding it with a wall or brick or limestone to keep off drafts, and then applying uniformly less and less heat with the torch. This process may take place at any time after the completion of the weld.

(Continued on page 29)

WELDING SHEET STEEL*

Welded Joints Compared to Other Types—Strength Secured by Welding—Use of Jigs Speeds Production

By J. L. Anderson†

THE fabrication of sheet metal into vessels, containers, and receptacles of various forms, and for innumerable purposes, progressed through the stages of soldered, riveted, and locked seams. See Fig. 1. All were more or less unsightly, and the application of special finishing processes was limited, due to the inability to finish the seam in keeping with the other portions of the article. The dimensions of such products had to be kept within narrow limits, due to lack of strength and dependability of the seams and joints, unless made excessively heavy.

The goal to which many manufacturers looked, was the ultimate stamping and drawing of their product, to overcome the difficulties and limitations due to seams, but this was prohibitive, until a reliable market had been created for their product and the possible continuous demand warranted the expenditure for the ponderous presses and die equipment

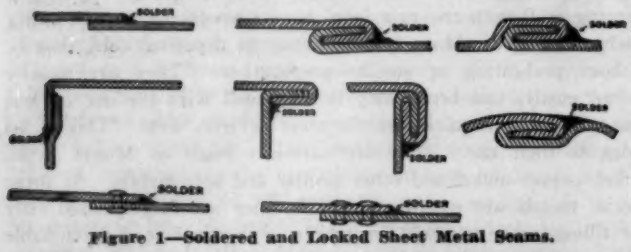


Figure 1—Soldered and Locked Sheet Metal Seams.

required. In many cases, the adoption of stamping and drawing often-times involved radical changes in design, necessitating the employment of finer grades of steel and increased the number of operations, so that whereas the finished product was far superior to the old, the cost of production was considerably higher, and necessitated a correspondingly high selling price.

The introduction of the welding process, now universally recognized as an efficient method of joining metals, produced a gradual change in manufacturing procedure. Progressive manufacturers were quick to recognize the advantage to be derived from the elimination of rivets and lock joints, and the greater value of the product with the smooth, neat, (or, if desired) invisible seams produced by welding.

Many sheet metal products present insurmountable difficulties in their manufacture by the stamping method; some of these difficulties have been overcome by the use of the oxy-acetylene torch, and it is now being extensively used to unite stamped or drawn sections into a symmetrical and seamless whole. Some manufacturers have redesigned their product, in order to combine the advantages of the oxy-acetylene welding process with old seaming methods. There are numerous products which, due to their form and the service required of them, or for economic reasons, are a better product, by reason of this combination.

The determination to manufacture by the oxy-acetylene welding method gives rise to the necessity for consideration of a number of vital points; gauge, preparation, cost, sequence of operations, jigs, finish of seam, and purpose for which article is to be used.

Design

The problem of manufacturing is primarily one of design, and consideration must be given to every factor which might affect production. A number of designs must be worked out to provide for the most efficient operation, and the simplest means of handling. The application of gas welding is not different in this respect from any other manufacturing problem, with the exception that where hand welding is employed, there is seldom the same demand for exactness as when a mechanical operation is specified. There are, however, a number of points to be considered, all of which are important.

The various types of welds which may be used, or required, must be considered, and the work planned to enable the operator to make the weld with the smallest expenditure of labor and gases.

We find a need for butt, lap, corner, spot, reinforcing and edge welds, in various types of production; each has its place, and preparation must be made so that the full value may be secured. See Fig. 2. It is often found necessary to employ several types of welds in the same part; this is frequently due to some peculiarity of construction, and in other cases may be necessary by reason of the service required of the article. Take, for example, the welded range boiler in which the longitudinal seam is butt welded, the joint between the head and shell lap welded, while the bottom and shell are edge welded together.

A mistake in design where welding is to be employed is a serious matter, and it is essential that the engineers responsible for the design confer freely with the welding department heads, or consult engineers experienced in the solution of all types of welding problems.

There are numerous instances of manufacturings designs incorporating various types of seams or joints in the same product. These designs are the result of long experience and have been adopted for economical reasons, or because there are providing reinforcing means of some kind, which gives the required strength to the weaker types of seams. In every case, the seam or joint subjected to the greatest strain is the one that is always welded.

Butt welds are the most common type of welds encountered; they are simple and easy to make. This is particularly true if the article is cylindrical in form and it is also true of edge welds.

Figure 2—Butt, Lap, Corner, Spot and Reinforced Welds in Sheet Steel.

Lap welds are seldom used, except in concealed positions, and principally in construction work where strength is not the main consideration.

Some manufacturers have combined both riveting and welding in the seam; the riveting operation being performed prior to the welding. See Fig. 3. This is a questionable practice, indicating a lack of faith in both operations; in fact, a large portion of the value of the riveted joint is lost, due to heat absorption, which tends to loosen the rivets and subjects them and the weld to an initial shearing stress. This is particularly true, in the lighter gauges, due to the proximity of the weld.

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†Industrial Engineer, Air Reduction Sales Co.

Reinforcing and spot welds are usually employed in connection with some mechanical method of joining, and are used to impart additional strength and stiffness. A good example of sheet metal production, employing welds of these types, is automobile metal body construction; here it is absolutely essential that there be no distortion, nor marring of the surface. The oxy-acetylene weld is admirable for this purpose, as it can be made of any dimension to impart the required strength or stiffness.

Strength

The adoption of sheet metal for the construction of vessels, containers, or parts for mechanical purposes, usually results in a product many times stronger than actually required to resist the tensile stresses to which they may be subjected. With this excess strength in the material, the oxy-acetylene weld employed in production welding with the usual reinforcement, is of sufficiently greater strength to insure full seam value.

In the welding of steel barrels, however, there are certain types in which deformation of the cylindrical shell is produced in order to get a stiffening effect, and in this operation the weld is stressed much beyond the elastic limit; even

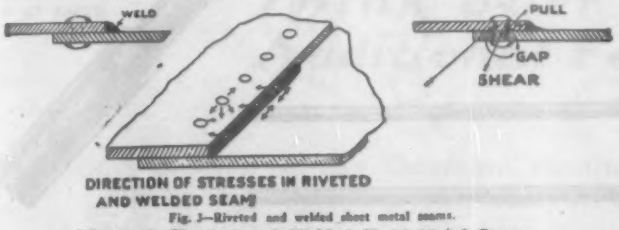


Fig. 3—Riveted and welded sheet metal seams.

Figure 3—Riveted and Welded Sheet Metal Seams.

under such severe stressing comparatively few defective welds are found, and very few fail in service.

The production of welded steel containers include certain types which employ a combination of welded seams and bosses, while the heads and bottoms are double seamed to the shell. This double seaming operation is an extremely severe test of the longitudinal weld. The first operation is the spinning of a half-inch flange on the shell a severe test in itself. The subsequent operations finally leave the edge turned inside out and rolled with tremendous pressure to permanently set the metal and leave a gas-tight joint.

The test required for the Interstate Commerce Commission of a welded steel barrel, which is given below, is a very severe test, and requires perfect welds of considerable strength and ductility:

Specification No. 5 requires a test of 15 pounds per square inch, with air under water, and a 40 pound hydrostatic test, in addition to dropping upon a concrete foundation from a distance of four feet when filled to 98 per cent of its capacity, without leakage. Specification No. 5A requires test of 15 pounds and 80 pounds respectively, and a six-foot dropping test, without leakage.

The manufacturer who decides that oxy-acetylene welding will play an important part in this scheme of production, does not face the necessity of providing a large plant area for the accommodation of expensive machinery. His production problems are often so simplified that the installation of comparatively few simple and inexpensive machines and jigs, will make possible a large production of fairly intricate sheet metal parts.

The welding equipment usually employed in manufacturing welding operation consists of hand welding torches which are obtainable in various types, and in several sizes. In connection with the torches there are required pressure regulators which reduce the line, or tank pressure, to that required for torch operation. Torches should never be operated unless the pressure is controlled by individual regulators, because uniformity of pressure is absolutely essential for efficient operation.

The acetylene gas supply in large installations is often derived from acetylene generators, which produce the gas direct from calcium carbide, automatically, as required. In

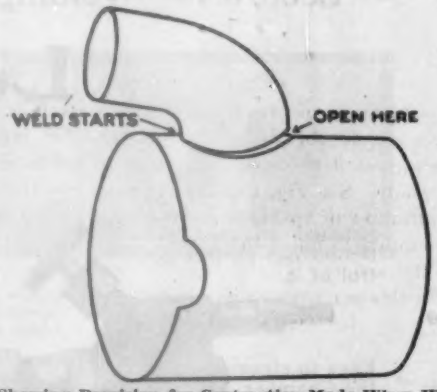


Figure 4—Showing Provision for Contraction Made When Welding Sheet Steel Muffler Parts.

installations of this kind the gas is distributed through pipe lines to the various welding stations.

Numerous manufacturers avoid the expense of generator and pipe line installations, and resort to the acetylene cylinder containing dissolved acetylene for individual torch supply.

The oxygen for torch operation is derived from cylinders which may be used for individual torch supply, or connected in banks to a manifold, from which it is distributed through pipe lines at a pressure of from 25 to 50 pounds. At the individual welding stations, this pressure is reduced and controlled by sensitive pressure regulators to that required for the particular operation upon which the torch is used.

Perhaps the greatest application of the oxy-acetylene torch

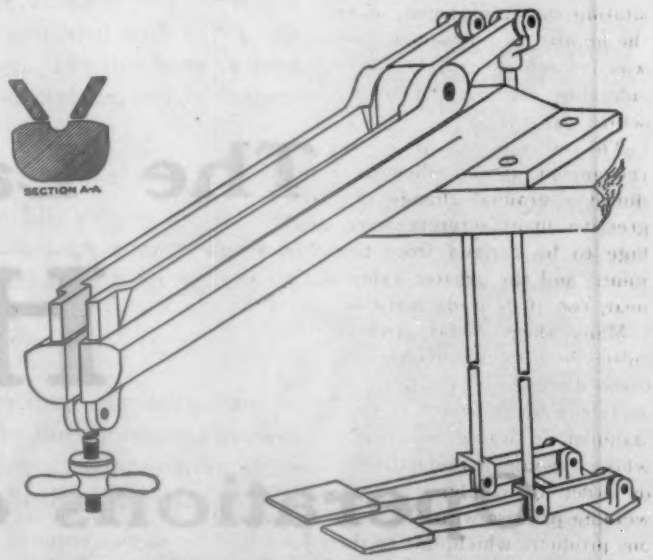


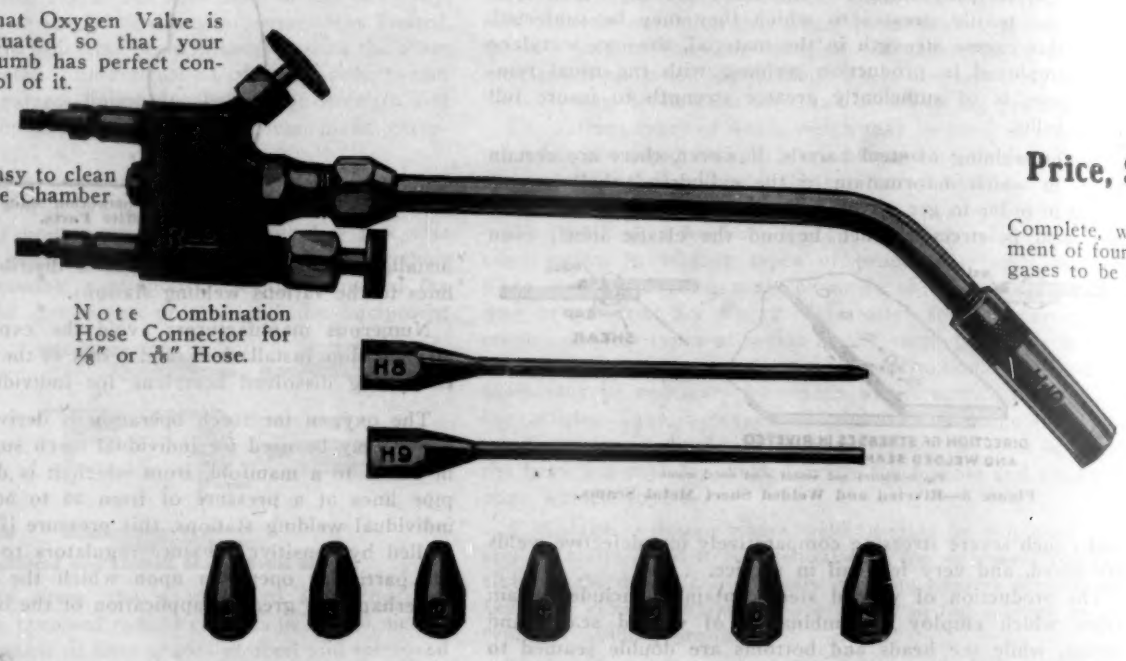
Figure 5—Welding Jig for Steel Barrels and Other Cylindrical Containers.

in production welding of sheet metal as examplified by a number of manufacturers, is in that class of production which employs a cylindrical shell, to which is attached heads or bottoms with filling or emptying outlets and connections, as well as means of handling. Under this heading would come steel barrels of various types, milk cans, ice cream cans, household utensils and kindred products. These products are of the simplest form, require only a simple type of equipment for production, are used in large quantities and

(Continued on page 44)

New REGO

Lead Burning Torch


That Oxygen Valve is situated so that your thumb has perfect control of it.
Easy to clean the Chamber
Note Combination Hose Connector for ⅛" or 3/16" Hose.
H8
H9

Price, $6.00

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Welding plates to strap.

"Sweating in" terminals to cables.

Removing compound from around cells to assist in their removal. (Flame from No. 10 tip is ideal.)

Welding terminals to pillar posts.

Think over these Additional Features

ASIDE from very convenient construction, the REGO H lead burning or welding torch takes care of a wide range of work. It will successfully handle metals up to 16 gauge in light welding, is useful for lead burning and other battery work, such as uniting cell connectors with the posts, melting compounds, etc.

REGO H will do dental, jewelry and other delicate jobs in which intense heat is required. TEN TIPS are provided with this torch so that all classes of fine welding jobs can be done. The tips have various size openings and are designed for use with oxy-acetylene, oxy-hydrogen, oxy-city gas, or city gas and compressed air.

THE length of the torch is 6½ inches over all, weight 3¼ ounces. The combination hose connections are spaced far enough apart to allow for the use of hose clamps if desired, and take both ⅛ and $\frac{3}{16}$ inch hose.

REGO equipment for all welding and cutting purposes can be obtained from the best jobbing concerns in the equipment market. The name REGO is a by-word for good welding apparatus from shore to shore. Write to-day for our catalog and further information concerning our line of equipment.

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CARE OF OXY-ACETYLENE EQUIPMENT

Points to Be Observed in the Handling and Use of Each Unit of the Welding Outfit

AN instructive and educational lecture was given by Mr. H. Thompson at a recent meeting of the Victorian Oxy-Acetylene Welding Association of Australia. A large number of members were in attendance, who were amply rewarded by Mr. Thompson's lucid explanations of the many troubles that welders had to contend with.

Mr. Thompson commenced by stating that the subject he was going to speak about would not only be interesting, but would be of some assistance to members in overcoming some of the many problems which the oxy-acetylene operator has to tackle. He further stated that he did not intend to specialize on any particular make of equipment, but would deal generally with them all. However, if any gentleman present had any particular torch or regulator about which he would like to ask a question, he would be only too pleased at the end of the address to answer them to the best of his ability.

Cylinders

Cylinders, when charged and handled with reasonable care, are perfectly safe, but if carelessly handled they become a menace to everyone who comes near them. Very often they are not treated with the respect due to them, as containers holding high pressures of gas; they got banged about and knocked over, and allowed to come in contact with red hot metal, which, apart from causing damage to the cylinder, causes the contents to become heated.

This increase in temperature causes the gas to expand, and there is then developed an enormous pressure in the cylinder, which, if it reaches the bursting point, would do considerable damage, and probably cause loss of life. Also, they are left exposed to the weather, which not only causes the deterioration of the cylinders, but also fluctuations of temperature and pressure in the cylinders through the gas expanding and contracting. The domes, which are provided to protect the valves, are often used as receptacles to carry oil or grease about the workshop, with the result that later on the same dome is placed on a cylinder, and the drippings of oil from it get all over the valve. As you are all aware of the fact that an oily surface exposed to a current of pure oxygen under pressure causes an explosion, you will see the danger that arises as a result of this thoughtless act.

There are many types of valves in use, but which type he uses does not concern the operator, so long as it is an efficient one and does not cause him any trouble. However, from experience, we find that certain defects do crop up, such as leaking glands; that is, when the cylinder valve is turned on the gas leaks up around the small threaded spindle. This may be overcome by screwing a regulator on to the cylinder, then opening the valve with two complete turns, and then screwing the gland a little tighter. On no account should the gland be unscrewed. Another trouble is that after the valve has been in use for some time the threads show signs of wear, through having had various regulators screwed on to them. This trouble can very often be overcome by removing some of the leather washers that are in the connecting adapter. In the event of a valve being so tight that it cannot be opened by fair means, such as tapping the key lightly with a hammer, it is best to return the cylinder to the depot, where it can be treated by those who are responsible for its efficient working.

What I have said about cylinders and valves is applicable to all cylinders containing gases of any kind.

Acetylene Generators

There are two types of acetylene generators in use throughout the welding shops: the carbide to water and the water to carbide.

Firstly, I will deal with the water to carbide type. Care must be taken in this type to prevent overheating of the generating chamber. This is caused by rapid generation of gas and insufficient outlet for the gas. Secondly, very often too much carbide is placed in the tray, which when it starts to get saturated with water swells up and blocks the gas passage from the generating chamber to the bell. Thirdly, that we must always use sufficient water on the carbide to get the maximum output of gas per pound of carbide used.

Carbide to Wafer Type.—One of the troubles associated with this type is caused by insufficient water in the generating tank, which allows the carbide to lie in a half-digested state, and later the tank is filled up, and then there is a rapid generation of gas, and most likely an over-supply of acetylene, which the bell is unable to accommodate, and it is therefore wasted. Trouble is also caused by the sludge tap at the bottom becoming stopped up. This is very often caused by not using it every time a fresh supply of carbide is placed in the hopper at the top. In large generators, where large supplies are placed in the hopper at one time, it is necessary to use the sludge tap daily. After flushing the tank out, it is always necessary to replenish the supply of water in the tank. Failure to do this is very disastrous, as I will show later on.

Gas Purifier

The work that we expect this part of the plant to perform is very often done in a very unsatisfactory manner, the main reason being that the material with which it has been charged is left too long without being stirred up, and it gets matted together. The gas is then forced to find its own outlet, which it generally does by coming up the sides, or by forming chimneys through the purifying material. This can be avoided by taking the material out periodically. Very often the gas is stopped through water collecting in the bottom. This can be noticed when you are changing the material. Though there might be acetylene in the generator, you may not be able to get any through to the hydraulic safety valve. This is generally due to water in the pipe line or tightly packed purifying material. When this occurs, it is advisable to have the pipe lines cleared out and the purifying material stirred up.

Hydraulic Safety Valve

If this valve is properly constructed and embodies an efficient water seal, it will always prevent a very severe backfire from getting beyond it in the direction of the generator, even if it is itself destroyed. I will deal with explosions in this valve later on.

Regulators

There is a considerable assortment of regulators in use at the present time, but they are all out to get the same result—namely, a reduction in pressure from that in the cylinder to that desired for use in the blowpipe, together with the sufficient volume. We are particularly interested in two types—the low pressure, which will deliver a maximum pressure of about 30 lb. per sq. inch, and the high pressure, which will deliver any desired pressure up to approximately 200 lbs. pressure. This part of the equipment is somewhat complicated, and is very much used. It has to deal with variable

pressures, and at times it becomes a bit troublesome. As all the regulators are built on much the same inside working lines, I will deal with one, of which I have a diagram. The hexagon nut is very often the source of trouble, as there are sometimes too many or not enough washers to make a satisfactory joint. At other times dirt is allowed to get into the regulator off the floor or bench. Again trouble is announced by a thundering noise in the regulator, this being due to the valve being allowed to vibrate on its seat, on account of the springs and diaphragm not being properly balanced. By tightening the adjusting screw, this can very often be stopped. Sometimes whistling is caused by the ebonite valve having partly buried itself over the seat and becoming jammed, causing a casing around the seat similar to an ordinary factory whistle. When this occurs, a new seat is required. When too much gas comes through the valve it is due to worn valves, and they ought to be replaced with new ones, as this very often causes the diaphragm to become distorted and often breaks it.

Strained Gauges

A gauge can be strained by leaving the adjusting screw tightened up when changing from a cylinder that has just been emptied to a full one and then turning the cylinder valve on full. This is applicable to all regulators, either high or low pressure type. I might further state that, as all cylinders containing combustible gases, such as C_2H_2, H or coal gas, are fitted with valves having left hand threaded outlets, the regulators for use with these are fitted with left-hand adapters.

Explosions

Before going on with blowpipes, I will deal with explosions in the various parts of the equipment which I have gone over In cylinders and valves there are three kinds of which I know—

(1) That which is caused by careless handling. This, of course, can nearly always be avoided.

(2) That which is caused by the use of oil or grease about the fittings. This is caused by friction and oxidation, and can also be avoided.

(3) That which is caused by concussion. This is of very great importance to users of gases that are stored under pressure. It may be caused in the cylinder valve—by part of the valve becoming choked up, and then when the valve is wide open it comes away with a rush. It may destroy the valve, and the operator near to it may get a splinter of brass in his hand.

Regulator

The same thing may very easily happen to the regulator, and is caused by having the adjusting screw tightened hard up when the cylinder is turned on full and quickly, and this allows high pressure gas to come away through the small hole in the seat with great velocity. When an explosion takes place through this cause, it nearly always partly destroys the casting, and the diaphragm is burnt out. In all cases this has to be replaced with a new one.

Generator

The main cause of explosions in the generator is fire, and there are two ways of causing that fire. The first and most likely to occur is by bringing a naked light too close to the generator when it is being attended to—perhaps the attendant is recharging or cleaning it. The second is by spontaneous combustion. In the water to carbide type this is caused by not having had sufficient water on the carbide, and a stoppage in the gas outlet from the generating chamber to the gasholder. This caused the carbide to generate a great heat, and to smoulder away, and then when the front is opened the pressure is liberated, causing the smouldering mass to burst into flame. If the necessary precautions are taken, the explosion can be avoided.

The cause of spontaneous combustion in the carbide to water type is really only shortage of water in the generating tank, the addition of water to the smouldering mass making generation of gas and fire at the same time, with only one possible result. The same precautions are necessary to deal with this as with the water to carbide type.

Hydraulic Safety Valve

When an explosion takes place in this part of the equipment, it is mainly caused by faulty construction in this respect—that when a backfire from the blowpipe takes place, the water in the valve should be displaced through the water column, but the seal must remain intact. This can only fail to occur if the water seal is not sufficient. As a blow out in this valve nearly always takes place when lighting up the torch, I will show how that can be avoided when I am dealing with backfiring in the blowpipe.—*Australian Automobile Trade Journal.*

REGO H FEATHER WEIGHT WELDING TORCH

One of the latest additions to the Rego line of oxy-acetylene welding and cutting apparatus announced by the Bastian-Blessing Company of Chicago, is listed as the Rego H torch. The range of work which can be handled by this little tool includes metals up to No. 16 gauge. Its lightness and ease of control makes it especially popular with battery manufacturers, battery service stations, dental and jewelry manufacturers, auto radiator repair

Rego H Torch

men and electrical repair men. It can be used with acetylene, hydrogen, city gas, or any other available fuel gas. Special tips are provided to give the best results with the various gases. The length over all of this torch is 6½ inches, and its weight 3¼ ounces. It has a combination hose connection so that it can be used with ⅜ or ¼ inch hose. Special construction features which have been emphasized in announcing this new product are the convenient locations of the oxygen valve and the ease of cleaning the chamber.

ARC WELDING CAST IRON

(*Continued from page* 23)

If, however, the shape of the piece is such that the cooling strains resulting from the quick application of the heat of the electric arc would be liable to warp or break it, the annealing should be performed directly after welding. The actual process is exactly the same. On pieces of this kind, a combination of slight preheating and thorough annealing will produce a perfect job. This method results in making either a steel or cast iron weld perfectly machinable, and in the case of the cast iron, produce a weld which is not discernible from the original cast iron by either chemical or physical analysis.

In conclusion, the most important thing to remember about cast iron welding is that its peculiar properties should be always kept in mind, and adequate steps taken to prevent any difficulty which these properties of general brittleness and lack of tensile strength may give rise to. With this point ever in mind, the operator will find that he will experience but little difficulty in mastering the welding of cast iron.

The Welding Engineer

Reg. U. S. Pat. Office.
Published on the 17th of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,
608 S. Dearborn St., Chicago, Ill.
Telephone Wabash 7134.

L. B. Mackenzie.....President and Editor
H. S. Card.....Associate Editor
R. L. Miles.....Associate Editor
W. W. Brothers.....Associate Editor

Subscription payable in advance and postage free.
United States and possessions and Canada.....$3 a year
Foreign Countries.....$4 a year
Single copy, domestic.....25 cents
Single copy, foreign.....30 cents

Entered as second-class matter January 29, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 1:00 a. m. on the 15th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails.

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Speed of Welding

ANSWERING the question as to the best method of determining welding speed, one of the best authorities in the industry has responded that there is no such thing as speed of welding. His opinion will undoubtedly be backed up by every one in the industry, except the more radically inclined. It is well to recognize the impossibility of adopting any set formula for arriving at speed figures for the purpose of comparison. The same operator, for example, will show different results as far as the day's production is concerned in two different plants, if his material is well prepared and set up for him in one plant and not in the other. Again, on the heavy or very difficult jobs, much better results from the point of view of both quality and speed will be obtained from two men working together than will be possible for each of these two men to accomplish if they work independently. There are a good many typical jobs which are better done fast for the sake of the quality of the weld rather than to lower the production cost, such as the welding of seams on very thin sheets, and there are other jobs which demand that the welder work fast and also take his time, as in the welding of alloy steels, in which case he has to avoid using unnecessary heat on the parent metal and also occasionally remove the heat and allow the job to cool. Speed is always a secondary consideration when a real weld is specified.

Passing of the Rivet

IF the public succeeds in the present campaign to reduce the retail price of gasoline, the oil companies are bound to be more than ever interested in the processes which will contribute to a reduction of operating cost. In view of the amount of publicity which has been given to the utility of the welding processes in tank construction, it is hardly necessary to review in detail what has been accomplished in developing applications of welding for the oil producers. It has been one of the most important activities of the welding industry during the past year. Hundreds of designs for small tank construction have been perfected, standard designs for tanks of 5,000 barrel capacity have been worked out, and complete construction details supplied, and the welding of bottoms and roofs on tanks of 80,000 barrel capacity has paved the way for the construction of all welded mammoth tanks. It has been pointed out that these tanks pay for themselves by the elimination of gas losses through evaporation. The refining companies and pipe line companies should not be hard to convince. The rivet will soon have to leave the oil fields and look for another job.

Find More Jobs for the Welder

MANUFACTURERS who are interested in the possibilities of using welding equipment often feel like turning it down because there is not sufficient volume of the particular operation for which the welder is desired to keep it in constant operation. Then it becomes the duty of the salesman or service man to suggest other means of keeping the equipment busy. In case of a factory of any considerable size, the first suggestion is usually the possibility of repair and reclamation work on broken and worn machinery parts. The welding outfit can also be made to pay its way by securing small production contracts from other factories which have a small volume of this type of work. In some cases the manufacturer has secured for his organization a first-class welding operator and started him practically in business for himself with a job welding shop, the primary purpose being to use the shop facilities for the manufacturer's own production work, giving the man in charge an opportunity to use whatever time there is left to increase his income. There is always some good arrangement which can be made to make it profitable for the manufacturer of metal products to use the welding process.

Meeting the Demand

To meet the constantly growing demand for Prest-O-Lite service, Prest-O-Lite's cylinder factory is distributing an ever-increasing number of new cylinders.

Years of experience in the manufacture and distribution of Dissolved Acetylene has established a high standard for every Prest-O-Lite cylinder—a standard that Prest-O-Lite unfailingly maintains by making its cylinders to its own design and under its careful supervision.

An inquiry at our nearest sales office will bring you information concerning our latest sales and service plans.

Each Prest-O-Lite user looks to his nearest District Sales Office not merely for arrangements to adequately cover acetylene needs, but for helpful co-operation and advice on any matter involved in the use of acetylene.

THE PREST-O-LITE COMPANY, INC.

General Offices: Carbide and Carbon Bldg., 30 E. 42nd St., New York City

In Canada: Prest-O-Lite Co. of Canada, Toronto

District Sales Offices

Atlanta	Chicago	Detroit	New Orleans	Pittsburgh
Baltimore	Cleveland	Kansas City	New York	San Francisco
Boston	Dallas	Los Angeles	Philadelphia	Seattle
Buffalo		Milwaukee		St. Louis

Prest-O-Lite

DISSOLVED ACETYLENE

L. O. X.
Safe Explosives

Liquid Oxygen Explosives are a fine example of the dependence of engineering and industry upon scientific research. They are a type of Sprengel explosive. The novel feature is that the oxidizing agent (liquid oxygen) and the combustible substance (carbonaceous matter alone or in combination with liquid hydrocarbons or even metallic powders, and, at times, inert absorbents) are brought together immediately before use. The components separately are non-explosive. Before L. O. X. could be seriously considered for commercial work, it was necessary to produce liquid oxygen economically in large quantity and to have satisfactory containers.

Liquefaction of so-called permanent gases, air, nitrogen, oxygen and others, long baffled those who attempted it, and yet required no unusual equipment once fundamental laws were known. Repeated endeavors to liquefy these gases by pressure alone, despite development of elaborate equipment for producing pressures up to 60,000 pounds per square inch, failed; one law had been overlooked, that all gases have not only a critical pressure, but also a critical temperature. Thomas Andrews, in 1869, was first to show that there is a temperature for every gas at and below which it can be liquefied and above which it cannot be liquefied by pressure; further, that when gases heretofore regarded as permanent were at their critical temperatures, they could be liquified by comparatively moderate pressure. Louis Cailletet, in 1877, produced the first liquid air by allowing the pressure on previously compressed air to fall 4,500 pounds per square inch, thus lowering the temperature. In 1895, or somewhat earlier, Linde in Germany, Hampson in England and Tripler in America, demonstrated that liquid air could be produced upon a large scale. Later Claude found it more economical to cause the air to do work in expanding by passing it through an engine instead of expanding it through a nozzle.

Not until 1902 did Linde demonstrate that liquid air could be separated into its constituents by passing through a special still, similar in principle to that used for separating alcohol-water mixtures. This rendered possible the production of liquid oxygen on a large scale. To-day it is practicable to produce it upon any scale desired, employing air pressures of 900 to 3,000 pounds per square inch. Liquid oxygen boils at —182.93 degrees Centigrade; to be used without excessive evaporation loss, satisfactory storage and transport containers were necessary. Dulong and Petit were probably first to discover that passage of heat through glass by conduction could be greatly reduced by a vacuum wall; d'Arsonval, in 1887, was first to make practical use of glass-walled vacuum containers, reducing evaporation loss to 1/10 that in plain glass. It was soon discovered that a vacuum did not prevent passage of radiant heat. Dewar, in 1892, found that silvering the inner walls of vacuum chambers of containers reduced evaporation loss to 1/200 of a plain glass container's loss. These containers were admirable for laboratory use, but fragile. There was needed a metallic container with low evaporation loss. Dewar discovered that properly treated charcoal, at the temperature of liquid oxygen, had the property of absorbing large quantities of gases, including air, so perfectly as to produce a very high vacuum. He secured a British patent in 1904, and in 1906 pointed out that a high vacuum could be maintained between metallic walls by this means. Modern metallic containers for liquid oxygen are rugged, highly efficient devices.

These scientific developments and actual trial of L. O. X. had been made before the world war. When Germany was cut off and it became necessary to find a substitute for large quantities of explosives used for civilian purposes, incentive came for rapid development of these new explosives.

L. O. X., under certain conditions, have distinct advantages: substantial saving in cost, greater safety, freedom from noxious gases, no possibility of explosive in ore or waste rock, which may occasion trouble; elimination of danger from drilling into unexploded charges. In cities, where large quantities of explosives are used in excavating, there is ever present danger attendant upon transportation through the streets and risks of their falling into the hands of miscreants. These hazards can be eliminated through use of L. O. X. L. O. X. have certain disadvantages. They are not so convenient in inaccessible parts of a mine, nor have they been used successfully for shaft-sinking, or under water. Under no circumstances should they be used in gaseous or dusty coal mine. We may still look forward to important improvements through research in this interesting development of a valuable commercial use for one of the constituents of the air which surrounds us.

*Based upon information supplied by Galen H. Clevenger, Consulting Metallurgist, U. S. Smelting, Refining & Mining Co., Boston, Mass. Details can be found in a paper by Michael H. Kuryla and Galen H. Clevenger, presented to February, 1923, meeting of American Institute of Mining and Metallurgical Engineers.—Research Narrative No. 59, Engineering Foundation.

DISCOVERED!
The Donor of the G. P. A. Golf Cup.

For several weeks a mystery surrounded the real story of the trophy cup for which a very exciting golf tournament was played at the recent convention of the Gas Products Association at Excelsior Springs, Missouri. The mystery is no longer a mystery. August 7th was the occasion of a similar tournament at the Green Valley Golf Club at Wheaton, Illinois, when about a dozen members of the Association started playing for *The Welding Engineer* trophy. A competent photographer was assigned to the task of securing the picture of the man who furnished the cup at Excelsior Springs and turned out to be none other than Mr. E. A. Faulhauber of the Burdett Company. It will be noted from the photograph that Mr. Faulhauber is a natural born golf player himself. This accounts for his desire to stimulate interest in the game on the part of other members by organizing tournaments. His activities in this direction have been much appreciated by the welding golfers of Chicago, particularly his thoughtfulness in reserving seats in the dining car for the trip to the country club. One interesting fact which does not show up in this photograph is that Mr. Faulhauber is probably the best barefoot golfer in the Gas Products Association. On the date of the first play at Wheaton he converted Mr. Price, Secretary of the Association to his style of playing and he states that if the weather is favorable when the final round for *The Welding Engineer* Trophy is played on August 21st, he will secure other converts.

Ernie Faulhaber With His Shoes On.

It is reported that the Linde Air Products Company will soon commence their erection of the first unit of its new plant in Tulsa, Okla., for the manufacture of oxygen.

The Roselle Welding and Machine Works has been organized by Mr. F. C. Milker and Mr. Logan Reynolds at Roselle, Ill. The new concern will operate a general welding and repair shop.

An addition to their present plant is being planned by Wilson Goggles, Inc. of Reading, Pa., manufacturers of welding goggles and other eye protecting devices.

Hints for the Welder

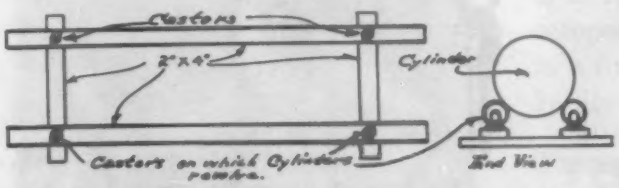
When you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work and how the job was done? Have you learned some little stunt every welder ought to know? Contributions to this department are paid for. Write it down any old way – I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today – the men on the firing line are waiting. L. B. Mackenzie, Editor.

SMOKE STACK MADE OF OLD CYLINDERS.

Editor:

We have just completed a job, some parts of which might prove of interest to other welders. The railroads in past years have discarded hundreds of acetylene lighting cylinders 9'4" in length by 20" diameter. They may be found at any point where the railroads maintain shops and can be bought for a small sum each.

The local city gas company purchased six of them and brought them to our shop to have a smoke stack constructed. The problem of driving out the gas and acetone was a puzzling one and after writing to several compressed gas companies and to other welders and receiving no satis-



Tanks Are Mounted On Castors for Convenience in Welding.

factory reply, we decided to try building a big wood fire around the tanks and this proved to be a satisfactory method.

After the fire had died down and we were sure the tanks were free from acetone, we cut the ends off and two of our men set to work with bars to remove the asbestos filler material. At the end of an hour they had accomplished little, so we drove a pointed bar into the material 2½ or 3 feet making a hole large enough to admit a half-pound, 60% stick of dynamite. When this was set off it so loosened the packing that it could easily be pulled out with a light iron hook. Most of the cylinders required two shots, one from each end.

After cleaning and lining up, the cylinders were welded end to end, making a stack 53 feet in length. Top ring and guy wire loops were also welded on.

These cylinders could be worked over into many types of servicable equipment, at a big saving over the price of new material. A very good compressed air tank could be made by removing one end, cleaning and then welding on again.

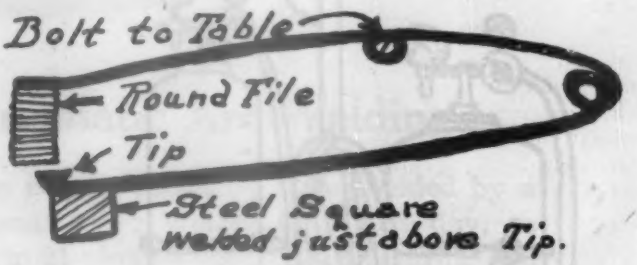
The diagram shows the rack we found convenient for revolving cylinder while cutting. Also, by holding a piece of chalk rigid at the end of the rack and revolving the cylinder it was possible to make a true mark for our cutting.

G. A. Work.

CONVENIENT TORCH LIGHTER TIP.

By Robert Balderson, Kansas.

Here is a handy way to make a torch lighter that will not burn your fingers and will stay put. Take one of the files from a flint torch lighter, preferably the round file type; then weld a thin piece of steel about one-half inch square just above the place where the torch light tip fastens on. Next put a bolt through a coil on the file side of the lighter as shown in the illustration. This bolt is used to secure the lighter in a convenient place on the welding table.



Torch Lighting Device.

After fastening the torch lighter to the welding table you are ready to light your torch. Turn on the acetylene, strike the square lightly with the end of the welding torch and your torch will instantly be lighted and your hand will not be burned. This little device will save you many minutes for it is always in the same place and you do not have to waste time looking for the usually misplaced match box.

SUPER HEATER TUBES

By R. P. Palmer

When superheater tubes are removed from a locomotive boiler the length is reduced several inches. To get the desired length again a piece is welded on the end that goes in the back flue sheet. This weld is made by coke, oil or gas and the piece that is welded on the tube is six inches long and is smaller in diameter than the rest of the tube.

After several welds have been added to the tube it is used for a smaller engine, as the superheater units will not go in the tube on account of the reduced size of the welded pieces. Now as usual the welder is called on to help out.

The welded end is cut at the first weld and pieces of tubes two feet long are cut. These we weld with oxyacetylene on the opposite end. The first trouble was that the metal extended through into the inside and would not admit the units.

We made a mandril four and three-fourths inches by four feet. The tube was five inches. This prevented the molten metal from extending through into the inside and also served to keep proper alignment of tube and piece to be added. We use the tank weld, holding torch still and moving the rod. It is necessary to keep the weld flush with rest of the tube or the tube will not enter hole in flue sheet.

Our first order called for eight, and after testing, we only had one leak. Seven minutes was the average time on our first order. Of course this time was for welding only, not counting the time for changing tubes.

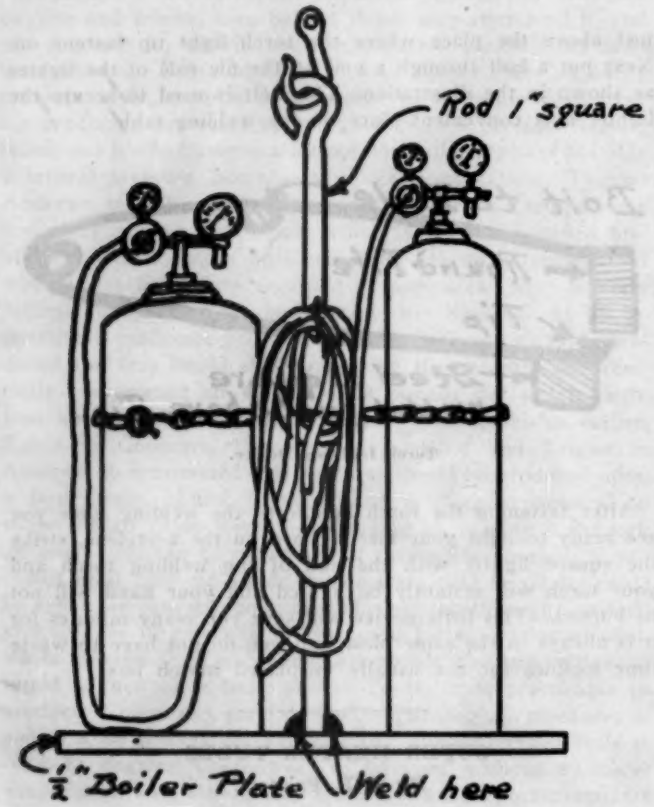
The next order was for twenty tubes and required one hour and forty minutes, an average of five minutes each.

We used ⅛-inch rods. One rod was sufficient to weld two tubes. In this order of twenty we had three leaks.

SAFE HANDLING OF GAS CYLINDERS

Editor:

Noticing an article on the subject of transporting cylinders through the shop in a recent issue of *The Welding Engineer*, I am sending you a sketch which shows another very safe way to handle them. I have used this device in the foundry, and found it to be both safe and convenient. There are so many sand piles in a foundry that it is impossible to use the ordinary two wheel truck for moving the gas tanks from one job to another.



Handling Cylinders With Safety.

I welded a piece of 1-in. square stock to a piece of ½-in. boiler plate, then made an "I" on the end of the square rod. I used a heavy chain to hold the tanks and welded on a couple of hooks to hold the chain to the hose as shown in the sketch. The "I" in the square rod is large enough to accommodate a good sized hook, and this device makes it quite a simple matter to pick up the complete welding outfit from one place and carry it to another without any danger of dropping the tanks or causing any injury to the apparatus.

R. P. Palmer.

NEW TORCHWELD REGULATOR

The Torchweld Equipment Company, Chicago, are announcing a complete new line of welding and cutting regulators in the following sizes:

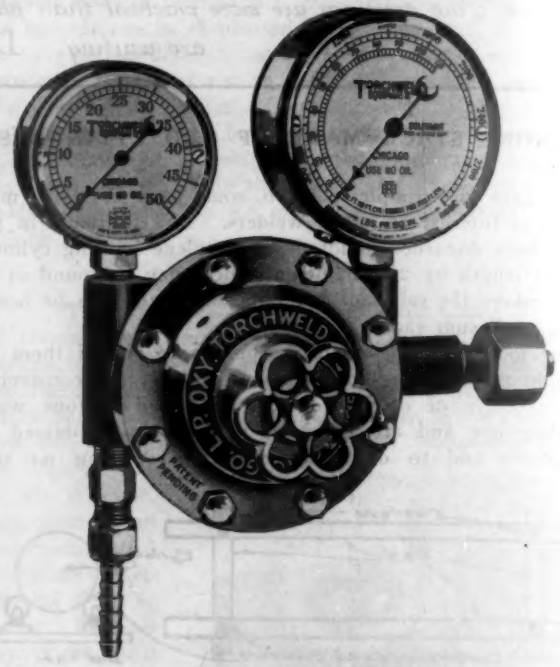
First; 2-inch in diameter, fitted with one working pressure gauge and with connection for cylinders or pipe lines.

Second; 2½-inch in diameter, fitted with one working pressure gauge and one gauge for indicating cylinder pressure. This regulator is for use when the gases are delivered at the higher pressures as in oxy-acetylene cutting.

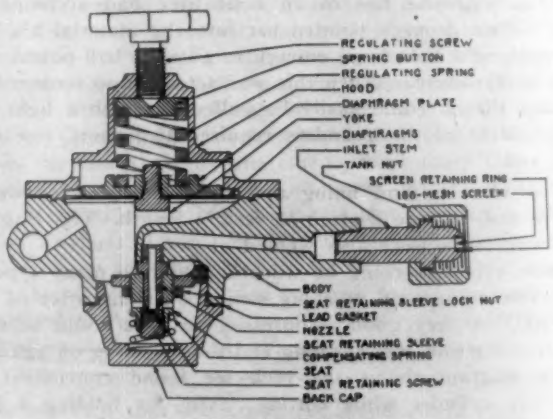
Third; 3-inch in diameter, fitted with either one working pressure gauge or with two gauges, one showing the cylinder pressure and the other for showing the gas delivery, and fitted with connections for cylinders or pipe lines.

The Duplex Regulator is also included in this line. It is equipped with three gauges, one for showing the oxygen cutting pressure, one for showing the oxygen welding pressure and one for showing the cylinder pressure.

These regulators are sturdily built and each one is fitted with three diaphragms of graduated sizes. These diaphragms are clamped into position between the regulator body and bonnet and are held tight when the bonnet screws are tightened. The internal working parts of these new regulators are carefully designed, and the manufacturers claim that their accurate fitting insures the correct delivery of gas for the service required of the regulator. Reference to the accompanying diagram indicates how the yoke holding the regulator seat is guided by the nozzle, thus preserving the alignment of these two parts. This is a desirable construction feature on account of the number of times the regulator nozzle and seat are brought together during the operation.

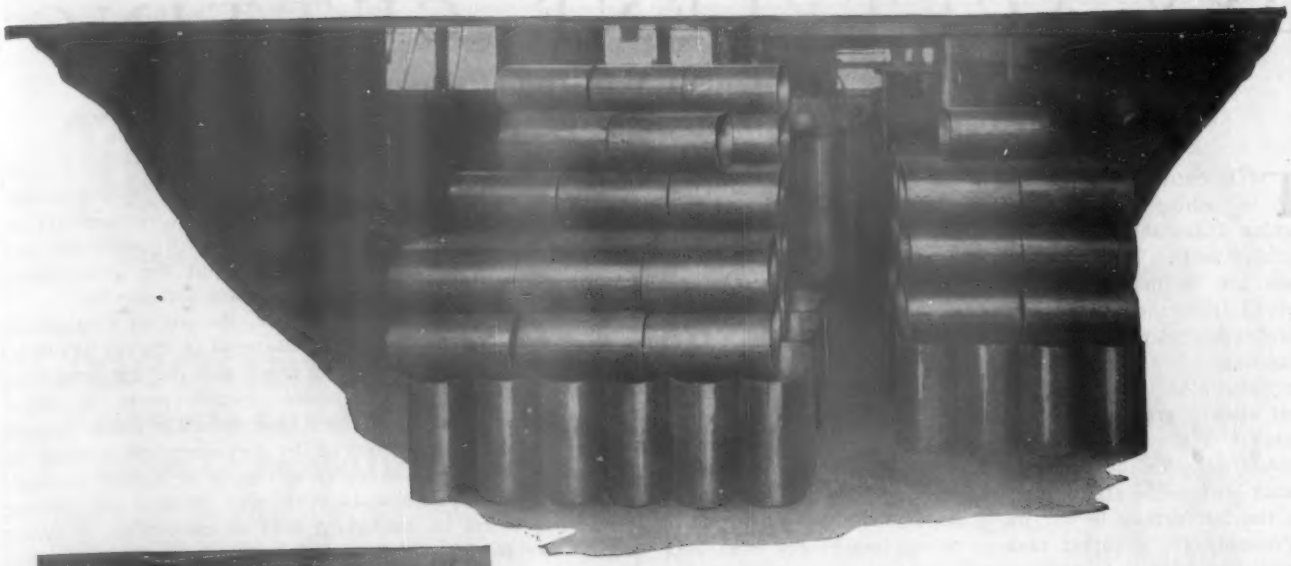


New Torchweld Oxygen Regulator.

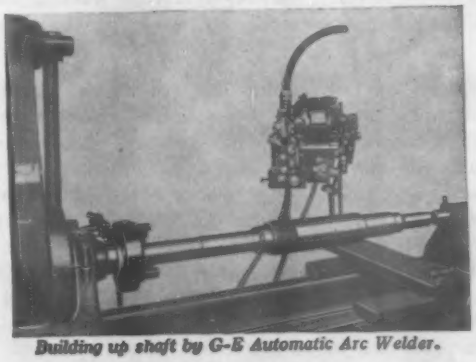


Regulator Details.

The construction of these regulators is well balanced and the design has taken into account the desirability of making replacements of diaphragms, seats, and other working parts with minimum difficulty. The manufacturers in announcing this new line, indicate their facilities for giving good service on each item.



Straight seam welding of tanks by G-E Automatic Arc Welder.



Building up shaft by G-E Automatic Arc Welder.

Automatic Arc Welding

The above picture shows 50 tanks welded by a G-E Automatic Arc Welder in a half day, as compared to 21 tanks welded by the hand method in a full day. The metal welded is 1/8" thick by 24" long.

Through this automatic application of the electric arc, a steadiness of the electrical conditions in the arc is obtained and maintained, resulting in a uniform and high quality of weld—and higher speed. Higher welding speeds produce lower welding costs.

The principal field for the G-E Automatic Arc Welder is the production, by welding, of duplicate objects in considerable quantities.

Its greatest use is for straight line seam, which is the simplest form of weld—but it also does efficient welding of circular seams, and in building up processes on metal.

G-E welding engineers will cooperate with you in making suitable applications of the Automatic Arc Welder to processes of production in your plant. Ask them.

General Electric Company
Schenectady, N. Y.
Sales Offices in all Large Cities

GENERAL ELECTRIC

45B-7[illegible]

OXY-ACETYLENE CUTTING*

Advantages of the Torch Cutting Process — Some Modern Applications—Straight Line Cutting Machines

THE cutting of metals with the oxy-acetylene blowpipe is finding an increasing number of applications in the regular manufacture and production of machinery and machine tools. The savings made possible by these applications are in many cases as important and the benefits derived from the use of the process are as great as in the more spectacular and more widely known applications. The scrapping of a battleship, or the cutting with an oxy-acetylene blowpipe, of a tangled mass of twisted structural steel after a great fire, for instance, may attract front-page space in the newspapers; but the savings and economics effected daily in the production of machinery parts will not attract such wide attention, although in point of actual saving the latter may be far more important than the former.

Probably the greatest savings in the machinery field accomplished with the oxy-acetylene cutting process are made through the elimination of special forgings and castings, and the substitution of parts cut from stock sizes of machinery steel, steel plate, bars, billets, angles, channels, and other readily obtainable material. In many cases the steel plate or slab construction is preferable to the use of forgings or gray iron or other castings, mechanical difficulties in shaping the former economically and accurately often having been the only serious deterrent to their use. The employment of oxy-acetylene cutting has now made it possible to handle this work speedily and with economy. The use of steel plate or steel slabs rather than special castings or forgings often makes possible the production of lighter, stronger machines. The cost is generally less than when special castings must be made, and in all cases the employment of stock material, by eliminating the delay incident to the production of special parts, cuts to a minimum the time necessary for production.

When a number of machines are to be built to specification, members shaped with the cutting blowpipe may be used to additional advantage. The cutting of the parts for a special machine may progress with the assembling, so that last-minute changes in design will not make it necessary to scrap costly parts; furthermore, such changes will not involve excessive delay for the preparation of the parts needed. In addition to cutting plate and shapes to size, and preparing frames, braces and supports, the oxy-acetylene cutting blowpipe is useful for cutting bolt and rivet holes, and slots and openings of all sizes and shapes. Straight or irregular cuts may be made with equal facility wherever needed, and at a saving in time.

On heavy material particularly, the savings in cost may be great. For one thing, the portability of the oxy-acetylene cutting outfit makes the transportation of the work from one part of the plant to another for shaping unnecessary. Then, too, billets, blooms, and slabs of such size as to make their handling with shears or saws difficult can be cut true to size easily and quickly with the blowpipe. This work may be done at or near the point of assembly, thus saving time and cost by reducing handling and transportation to a minimum.

Lately the practice has been finding favor, where important forgings are being cut to shape with the oxy-acetylene blowpipe, of preceding the cutting by preheating of the forging to a dull red if the depth of cut is more than five or six inches. Particularly in heavy sections of material of high carbon content this preheating will tend to eliminate strains and prevent checking. The cutting should be followed by normalizing the steel at a temperature of approximately 1650 degrees F., which will overcome any strains present after the cutting and put the grain structure of the metal in the best condition for service.

When time is an important factor, the use of forgings or castings may not be practical. Material is always available, however, from which machine parts may be cut, reducing the time necessary to produce special parts by other methods. Many manufacturers have found it much cheaper to prepare the parts required by oxy-acetylene cutting as they are needed than to carry a supply of special castings in stock. In experimental work this method of cutting metals has found an important field of usefulness. Full-size or part-size working models may be made without difficulty, eliminating the delay incident to the making of templets, castings, or pieces machined to shape and dimension. Changes in design suggested while the model is in the process of manufacture can be incorporated in the work at a minimum of delay, inconvenience, and cost.

When the oxy-acetylene cutting process is employed, it is generally unnecessary to provide specially designed mechanical equipment to form parts for extraordinarily large or otherwise unusual machinery. In practically every case, the cutting torch is all that is necessary to fabricate the parts, and a large investment in special and probably little used equipment is not required. The advantages of the use of oxy-acetylene cutting in forming new material are no more important than in working used and reclaimed metal. Often parts of obsolete equipment can be salvaged and, after being trimmed to the proper size and shape, employed in the making of new machinery. The possible reductions in cost through this application are evident. These may be particularly important when the oxy-acetylene welding blowpipe is employed to supplement the work of the cutting torch.

The possibilities of this application are almost limitless. In recent instances cases have been noted where machine guards, stair stringers, railings, passageways floors, small tanks for fuels or lubricants, idlers and guide rolls for belts, drip pans, and many other pieces of equipment have been made at very low cost from old pieces of angle and channel iron, steel sheet and plate, and wrought iron or steel pipe. In every case the material was salvaged and cut to size and shape with the cutting blowpipe; and in most cases it was formed by the oxy-acetylene welding process.

The large number of operations for which machinery builders are employing the oxy-acetylene cutting process illustrate the importance that has been attained by this method of cutting metals in the machinery industry. Recently a manufacturer of heavy machinery received an order that included thirty-two steel mill roll housings. The customer for whom the roll housings were to be made demanded rush delivery, and the time necessary to produce and deliver the forged housings would have made the fulfillment of the customer's demands impossible, had no other means been available for the production of the parts for which forgings had always been used.

In the emergency, however, the idea of cutting the parts from steel billets with the oxy-acetylene blowpipe was presented. (See Figs. 1 and 2.) It was tried out on a part

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"Quality Protects Profits"

TORCHWELD

Reg. U. S. Pat. Off.

Non-Flash Apparatus

Unequaled

Records for Success and Size of Installations!

The high standing TORCHWELD enjoys in the iron, steel and metal working industries has been earned—only as such things can be earned—by giving downright good value!

TORCHWELD patented construction provides many advantages, invaluable to the welding and cutting of metals.

Equal Consumption of Oxygen to that of Acetylene for welding.

Equal Gas Pressures for Welding, and lower pressures than usual for cutting.

Freedom from flash-backs—regardless of the size of the welding or cutting job, — gases properly mixed *beyond* heat radius of the work.

Positive safety, whereby any attempted flame propagation into the welding or cutting torch is expelled.

Consider also that TORCHWELD welding torches are machined from solid bar brass stock, and that principal parts of the cutting torches are similarly made; all permanent joints are brazed. Heavy duty welding tips are machined from solid bar copper stock, and are sufficiently heavy to make them sturdy, long wearing, and free from seating troubles. TORCHWELD torches are as well balanced as the beam on a scale; they do not tire the operator.

A comparison of qualities and prices will reveal values you will eventually require and demand in torches, regulators, and general welding and cutting equipment.

Buy Torchweld Now!

Torchweld Equipment Company

Fulton and Carpenter Sts., Chicago, Ill.

"You bet—Standard Carbide for every job"

Smiling Dave Okay

WHEN I started using STANDARD CARBIDE my work began to pick up. I could work faster because STANDARD is pure carbide, nothing in it to cause the flame to flicker or die and so slow up my work. Because I worked faster I could do more work and because the work I did with STANDARD was above the average, the boss got more jobs and I had more work to do.

When the boss talks about service now he's not just talking. He means STANDARD SERVICE and that's service with a capital S.

We're all strong for it, the foreman (that's me). because it gave me my reputation, the men because they do better work, and the boss because STANDARD costs no more than any other kind of carbide.

Smiling Dave Okay
(EXPERT CUTTER AND WELDER)

STANDARD CARBIDE not only gives a steady even glow of acetylene gas but it lasts longer and costs no more. It is absolutely free from all impurities. It is a favorite among expert welders and cutters.

STANDARD
TRADE MARK

CARBIDE

Burns Brighter—Lasts Longer

Standard Carbide Sales Co., Inc.

Main Office : : 15 West 37th St., New York

of the order, with such immediate success that the entire order was completed with oxy-acetylene cut parts, and this cutting process was adopted by the management as standard practice for this and all similar work of the future. An accurate check on the costs of cutting these members from slabs 3½ inches thick demonstrated that the oxy-acetylene cutting process resulted in a substantial reduction. The cutting blowpipe used in this instance was mechanically guided in a so-called straight-line cutting machine, as shown in Fig. 1.

Straight-line cutting machines are also being used to advantage in plants where follower blocks for railroad cars are cut from steel slabs. In one plant a heavy shear was formerly used, and the blocks rejected as above or below the required limits ran up to 18 per cent of the total number cut. The principal difficulty encountered was the tendency to make a cut which, on the very heavy material used, either did not start true or finish square. In this plant the use of the oxy-acetylene cutting blowpipe reduced the proportion of rejections to less than 1 per cent of the total number of blocks cut. At another plant saws were being used to cut the follower blocks. The chief disadvantages of this method were the time necessary for each individual cut, and the expense entailed in replacing saw teeth ruined by the heavy work. The cutting of a single block with the saw required an average of twenty minutes. This time was reduced, by the use of the oxy-acetylene process, to an average of less than one minute and thirty seconds.

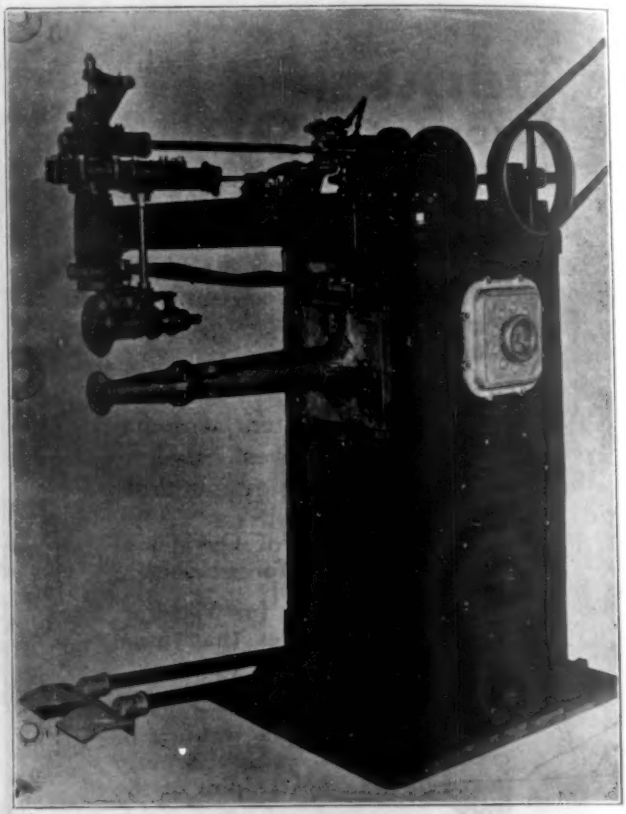
An instance of the use of oxy-acetylene cutting for special work is presented by a manufacturer of railroad contracting equipment whose products are largely made to customers' special requirements. The oxy-acetylene blowpipe makes possible the production of such equipment without delay for special parts, and minimizes the cost of effecting changes in design from corrections or alterations in the specifications. The railroad ditcher shown in Fig. 3 was built largely by means of oxy-acetylene cutting. The spreader arms were cut to size from tank steel sheets ⅝ inch thick. Manganese steel castings were cut to fit the irregular lower edges of the spreader arms. Channels, shapes, and angles were cut to size and shape for use as supports and manipulating mechanism. Likewise, the frames for the plows were cut to size and the car truck bolster and various supporting bars were prepared by cutting with the oxy-acetylene blowpipe. All of these operations resulted in savings over the methods formerly employed.

A manufacturer of press brakes uses the oxy-acetylene process for similar operations. In this instance 2½-inch machinery steel plate is cut to size and shape. Here the oxy-acetylene cutting process is employed primarily to provide stronger parts than the special castings ordinarily used. The manufacturer found, however, that in addition to accomplishing the object he had in view, the use of stock plate cut to size was less expensive than the use of castings. The time saved in this instance in the regular production of the press brakes was also of great importance, since immediate delivery of the machinery plate could be had in the quantity required. This company builds special machines and, although there are nearly always eight or ten machines in process of construction, there are seldom two of the same size or design. The sizes of the parts necessary vary greatly with each job and each kind and style of press. The wide range of adaptability of the oxy-acetylene cutting blowpipe aids this company materially in keeping the production costs at a minimum.

In this plant the material for each machine is delivered to the point at which the machine is to be completely built. As the assembling progresses, special parts and pieces are cut to size and fitted to the work. No finishing of the parts prepared in this way is necessary, as the oxy-acetylene cuts

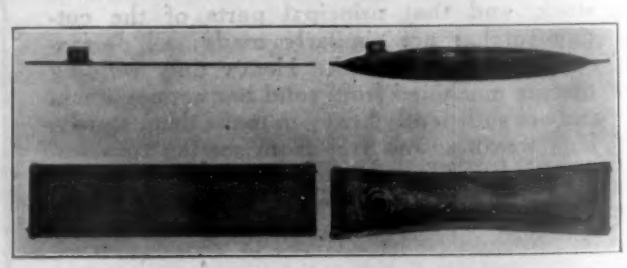
PRODUCT OF ZEUS SEAM WELDER STANDS SEVERE TEST

The seam welding of thin sheets by the resistance method has been the subject of considerable study on the part of manufacturers of electric welding machinery and has resulted in the development of ingenious and efficent machinery for this work. Among the recent developments in this line is the Zeus electric seam welder made by the Gibb Instrument Company of Bay City, Michigan. The seam weld is accomplished



Zeus Electric Seam Welder.

on this machine by passing the metal between two roller electros. One of the illustrations shows an interesting test which was made on some sheet steel welded by this process. Two pieces of steel sheet (16 gauge) were placed one on top of the other, and welded together along the sides and



Test Showing Possibilities of Electric Seam Welding.

ends. A vent had previously been welded in one of the sheets. Through this vent, hydraulic pressure of 400 pounds per square inch was applied. The result was the distortion shown in the photograph. At the left are side and top views of the welded assembly before pressure was applied and at the right similar views at the completion of the test. It is reported that no leaks developed anywhere. On the basis of the actual welding time, these side and end welds were made at the rate of 180 feet per hour.

SCRAPPING STEEL CARS

Electric Arc Process Proves an Economical Method of Reducing Scrap to Sizes That Can Be Cut in Shears

By E. H. Dralle*

THE electric arc has for some time been recognized as a most potent agent for the fabrication and production of mild steel structures, and as perhaps the most economical means obtainable for the repair of worn or broken steel members, especially where they are of appreciable thickness or volume; but as a means for reducing scrap material to convenient sizes for remelting, the value of the carbon arc has been only recently appreciated.

Perhaps the railroads, always among the first to exploit new welding developments and to experiment with new suggestions involving electric arc processes, stand to profit most by the widespread use of the electric arc as a means for scrapping steel, coal and coke cars. In the past, it was a common practice among many railroads to turn worn-out cars over to wrecking companies for dismantling, but the possibility of using the carbon arc advantageously for this service is resulting in the discontinuance of this practice and the adoption of a plan whereby all wrecking of cars will be done within the railroad shops. This condition will, without a doubt, result in a saving of time and expense.

Various Methods of Dismantling

Assuming that the car wrecking is done within the railroad shops, the problem demands considerable study to determine the best method of dismantling; that is, there must be a choice among:

(1) Cutting the heads off the rivets, and dismantling in the reverse order of assembling.

(2) Reducing the cars to suitable scrap sizes, entirely by cutting with the carbon arc.

(3) Reducing to sizes suitable for handling by four men, and finishing the scrapping by means of a large shear or shears, whichever is required to meet conditions.

These methods will be considered in order without regard to any peculiar local conditions existing to influence the adoption of any particular method.

Selecting the Most Economical Method

It is probable that scrapping by cutting the heads off the rivets would be found desirable where parts of the car could be salvaged for use in the repair of other cars. In fact, it is in this service where rivet cutting is most widely applied. It is doubtful, however, if this would prove a profitable scheme of scrapping cars, even though employed to a great extent by wrecking companies.

To work entirely satisfactorily, all rivets that are to be cut should be in a plane closely approaching the vertical, so as to allow the molten metal a ready means of escape. Attempting to cut the heads off rivets in a horizontal plane will result in actually welding the plates to the rivets unless means are employed to force the metal from its position as rapidly as it is melted, as for example by using a strong current of compressed air. Such a procedure would be cumbersome in manipulation, and for this reason, objectionable. However, in vertical planes this method of dismantling would compare favorably with straight cutting.

Time Required for Cutting Rivets

On an average coal car, there are approximately 1,400 rivets above the main frame of the car. With ⅞ in. diameter rivets, and a current value of 800 amperes, it has been demonstrated that an average of 8 seconds' actual cutting time is required per rivet. Obviously, then, the cutting time for a complete car would be 1,400 times 8, or slightly more than three hours. The discomfort caused by the use of these heavy current values makes it impossible for an operator to work continuously. This fact, coupled with the time consumed in moving from place to place will result in a working factor of perhaps 80 per cent, so that the cutting time is raised to 3 ÷ 0.80, or 3¾ hours.

After the cutting is completed, one man with an air hammer; or two men, one with punch and the other with a heavy hammer, must force out the stub ends of the rivets to complete the dismantling. This operation would require the greater portion of 1¼ hours, so that the time to dismantle a car down to the main framework is practically five hours.

The cost of scrapping a car by this method would be divided as follows:

Labor at 60 cents per hour—6¼ hours (5 hours for arc operator and 1¼ hours for helper to remove rivets)	$3.75
Power at 2 cents per kw. hr. (3 hours using 48 kw.-800 amp., 60 volts, from general efficiency of machine, 70 per ecnt)	4.20
Total cost, not including maintenance, interest on capital invested and depreciation of machine	$7.95

Adding to the above figure the cost for reducing the main framework of the car, would give a direct cost of about $15 for scrapping one car. The operating rates are not sufficiently fast to permit of one cutter scrapping two cars per day. To be practical, this schedule of two cars per day per cutter should be obtainable.

As pointed out, the above method is applicable where it is desired to salvage parts for rebuilding into other cars. Where cars are in such bad condition as not to warrant the saving of parts, best results are obtainable by using the straight cutting method to reduce to sizes suitable for handling by four men, especially since the cost of dismantling will be less than $10 per car as compared to $15 for the rivet cutting method.

To arrive at a figure upon which to base a cost for scrapping cars, a test, as will later be described, was conducted, and an accurate record kept of all results. The car was a standard coke car, having solid metal bottom, ends and half sides, the upper halves of the sides being of expanded metal.

Scrapping by Cutting Through Sheets and Frame

Starting at one of the four upper corners, immediately below the top supporting angle—this being left intact to make sure that the side would not fall out until the desired time—the cut was made down the corner to the floor of the car, thence along the entire length of the side, directly above the floor, and up to the other corner. The top angle-iron supports were then cut at the corners, and the side allowed to drop down. The time consumed was 51 minutes, and the distance cut was 43½ ft. The original thickness of material was ¼ in. sheet, but paint and rust in some places made the equivalent thickness in terms of clean iron sheets greater than ¼ in. On the other hand, corrosion was so effective as to reduce the equivalent thickness below ¼ in. in many places. One-fourth inch, however, can be taken as an average value for the thickness of material cut. It should be remembered that on account of the paint and scale on this iron, cutting conditions are entirely different from those experienced with cutting clean iron sheets.

*Westinghouse Electric & Manufacturing Company.

As soon as the car side was dropped to the ground, it was cut up into three equal pieces by making two cuts along lines parallel to, and equidistant from the ends. Each cut was through 2½ ft. of ¼ in. solid material, requiring two minutes' cutting time, and 3 ft. of expanded metal requiring 30 seconds' cutting time.

A similar procedure was used on the second side of the car, which was cut into the same number of pieces as the first side.

At each end of the car the car bottom sloped at an angle of approximately 45 deg. from the frame to within 3 ft. of the top of the car. The length of this sloping sheet is approximately 6½ ft. After cutting out both sides of the car, cuts were made across the car along the line described by the intersection of the sloping bottom sheets and the bottom of the car. This cutting, too, was through material ¼ in. in thickness. The length of cut was 9 ft. on each end, and the time of cutting seven minutes.

After cutting the ends as above described, it remained to cut four upright, 3 in. by 3 in. angles, and one 2 in. by 2 in. angle, all ¼ in. thick, directly above the car frame, to allow the ends to fall to the ground. The time required for this operation was seven minutes on one end, and four minutes on the other, the difference in the two times being due to the brake mechanism which had to be cut on the end requiring the greater time.

With the operations thus far, the car had been cut into eight pieces, three pieces on each side, and each end constituting one piece. To further facilitate handling, a cut was made the entire length of the car, parallel and adjacent to the center sill, and then two cuts were made across the bottom, directly back of each bolster. The lengthwise cut, 20 ft. long, required 40 minutes, and the cross cuts, each in effect being equivalent to 12 ft. of cutting, required 20 minutes each, or a total of 40 minutes. The greater portion of this time in making the crosswise cuts on the bottom was consumed in making the cuts through the center sill. The vertical members of the center sill together with the side frames, which approximated almost one foot in depth, account for the 12 ft. of cutting across the bottom of the car, which is only 9 ft. wide. Moreover, in making the lengthwise cut, it was also necessary to cut through two heavy channel door supports.

With the operations as described for cutting up the main frame and bottom of the car, it will be seen that the total number of pieces into which the car was cut was 14. Of course the whole truck on each end remained intact, but the cutting was done in such a way that the framework could be entirely removed from the trucks.

The object in cutting the material to sizes suitable for handling by four men, is in keeping with the scheme to have a large shear or shears to which these larger parts will be carried by the men for cutting up into pieces suitable for remelting.

It is possible for four men to handle the side and end pieces as cut, but on account of the heavy framework and material in the bottom of the cars, additional cuts are necessitated to facilitate handling. It will be found advantageous and economical to reduce these heavy parts to suitable sizes for remelting, without transporting them to the shears. The cutting could be done completely by the carbon arc.

To more clearly show the cuts which were made on the car, the number of feet for each cut, and the total time for cutting, Table I has been prepared.

Assuming that the operator's time is eight hours per car instead of less than four, as shown for the actual cutting time, the cost per car will still be less than $10, because only the item of the operator's time changes, the actual cutting time being the same whether the operator spends a full day on the car or a half day. To be perfectly exact, the power bill will slightly increase, because the losses of the set go on as long as the set is running.

To have one man (cutter) completely wreck a car for cutting into sizes suitable for remelting, would result in greater expense, since a shear can reduce the smaller pieces at a more rapid rate than can be done with the arc, and the four men employed to carry material to and from the shears could be utilized by several cutters. Some few men would necessarily be employed for loading the scrap, and a few additional could be used to advantage to assist in carrying material to and from the shears.

The cost of shears, interest on investment, and depreciation of the machinery must also be considered in this connection, but unquestionably these items can be more than favorably balanced against the extra cost of operators and machines to supply them in order to do equal amounts of work per day.

TABLE I.

Table 1—Details of cutting With Carbon Arc in Scrapping Steel Car Body

Location cut	Material cut	Length of cut feet	Number of cuts	Time per cut min.	Total feet cut	Total time min.
Lengthwise-side	¼ in. sheet	43.5	2	51	87	102
Crosswise cuts on side sheets	¼ in. sheet	2.5	4	2	10	8
	exp. metal	3	4	½	12	2
Ends in intersection of bottom and sloping bottom sheets	¼ in. sheet	9	2	7	18	14
*Upright angles on each end	3 in. by 3 in. by ¼ in. angle.	½	11	1	6	11
Cross cuts on bottom	¼ in. sheet and channels	12	2	20	24	40
Lengthwise cuts at bottom	¼ in. sheets and angles	20	1	40	20	40
Total					177	217

*For purposes of calculating, the angles on each end were taken as 3 in. by 3 in., and five counted in each end. One end had the brake mechanism mounted on it, which required practically three minutes' time to cut, making seven minutes' cutting time on one end, and four minutes on the other.

From the above table, the following costs were obtained:

Total number of feet cut (equivalent of ¼ in. sheet)	177 ft.
Actual cutting time in hours	3.61
kw. hours consumed (850 amp., 60 V., M. G. set eff. 80 per cent 64 kw. for 3.6 hours)	230
Cost of labor at 60 cents per hour	$2.16
*Cost of power—2 cents per kw. hour	4.60
Total	$6.76

*Two cents per kw. hour for power is only a basic figure. This should be much small, if power is bought in large quantities, or if the customer generates his own power.

Any one of the proposed methods of scrapping cars with the carbon arc will result in a great saving over the cost to do the same work with the acetylene torch. Paint, scale, and oxides which give way rapidly under the intense heat of an electric arc, are obstacles of no small importance when cutting with the acetylene. Furthermore, the cost of gas is one of the greatest items of expense, inasmuch as the torch is usually allowed to burn regardless of whether cutting is being done or not. With the electric arc, power consumption ceases when the operator fails to maintain an arc.

Aside from the cost of doing the work with gas, the inconvenience of hauling tanks, both empty and filled, to and from supply points, makes the electric arc (where power is always at the operator's command) stand out by far the more favorable of the two processes.

Equipment Required for Electric Cutting

The electric equipment for supplying power to the carbon arc consists simply of a motor-generator set and the necessary motor-generator control and cutting panel. A desirable form of machine is shown in the illustration. The set comprises a suitable motor, either a. c. or d. c., driving a low voltage compound wound d. c. generator. The generator is controlled entirely by a panel mounting a circuit breaker, ammeter, volt meter, and knife switch, as shown.

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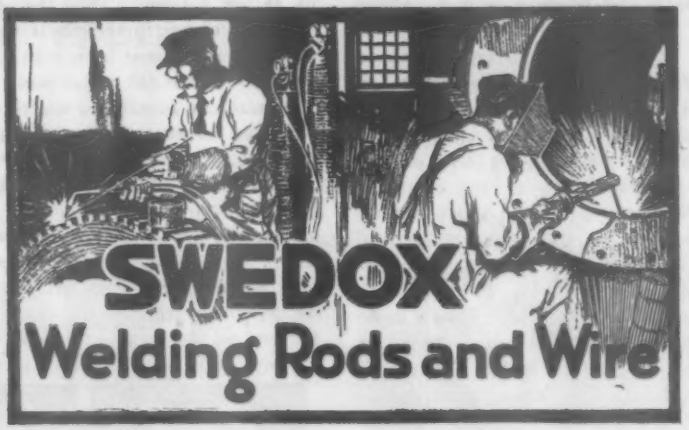

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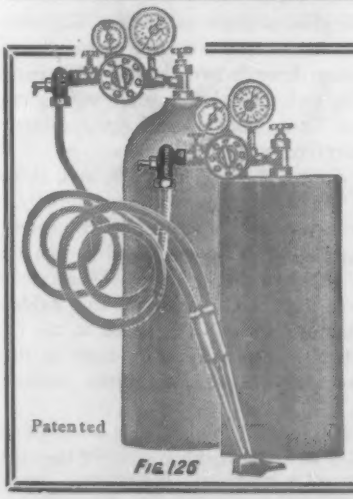

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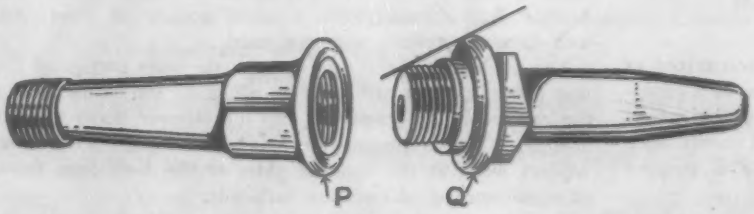

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In addition to the above equipment, there are required only a suitable mask, electrodes and holders, and a cutting resistor for each operator.

The cutting resistance is comprised of four frames of resistance mounted in an angle iron framework, having overall dimensions approximately 48 in. long, 33 in. wide, and 17 in. high. This complete unit is mounted on a trolley which allows the resistor to be moved along the car as cutting progresses. This feature eliminates a long electrode holder cable. The entire carriage can be easily moved along the trolley track by simply pulling on the properly secured electrode holder cable. On the front of the resistor unit is mounted a slate, 15 in. by 13 in. by 1 in. thick, having mounted on it two 200-ampere, single-pole, single-throw knife switches. These knife switches control resistance steps of such value that current values of 400, 600 and 800 amperes may be obtained for cutting service. The 400 ampere resistance step is permanently in the circuit, and each of the knife switches controls one 200-ampere step.

Plant layout is an important feature in the successful use of the arc process for scrapping steel cars, and while local conditions will largely determine the nature of each installation, experience has shown that best results are obtainable with a layout such as described in the following paragraphs.

It is preferable to have a separate building for this cutting service. The building should be divided into booths, accommodating one car each, and should be so designed that the motor-generator set, or sets, supplying power will be centrally located with respect to the arc cutters, power for which will be conducted along an overhead trolley. On this trolley, mounted on a carriage as described above, is the cutting control resistor with cable and electrode holder attached. The power for all operatiors is conducted through the trolley circuit, but each operator has his own cutting resistance, and can use any current value suitable for the work which he is doing. This arrangement of the power circuit positively insures non-interference among operators, regardless of how many are operating from the circuit. By having the resistance on a movable trolley directly above the operator, maximum cutting rates are obtained, since the movement of cables and holders to the most inaccessible positions on the car, is accomplished with minimum time and effort.

The object in having separate booths for each car is to protect operators from injurious reflected rays, and often, perhaps, direct rays from adjacent arcs. As a safety precaution, it is desirable to have only one operator per car, although with a properly outlined system of dismantling, it would be entirely possible to use two operators per car.

While the work done thus far on dismantling cars by the carbon arc process has shown that this method is decidedly superior to other methods of scrapping, it is entirely possible that a more widespread use of this process will result in new and improved means for wrecking cars, which will still further decrease the already low cost of dismantling by the arc process.—*Railway Electrical Engineer*

ARC WELDING A STRIPPER RAM

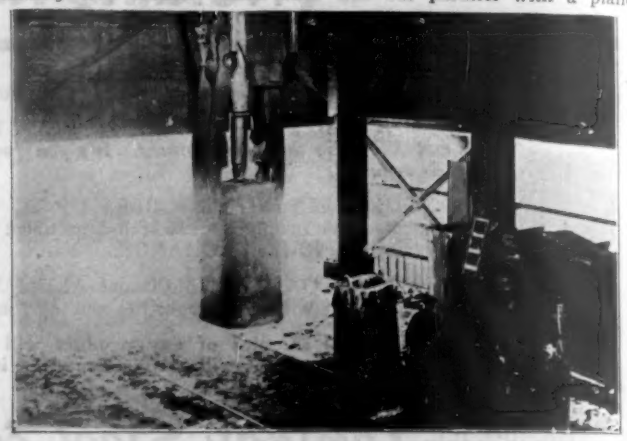
By A. M. Candy.*

The arc welding process is justifiably becoming recognized as a valuable repair method for a large variety of steel mill equipment. Quite frequently new applications are made which are of sufficient importance to be of interest to all steel mill maintenance departments. The writer considers the welding of a stripper ram to be in this category.

The ram under consideration is ten inches in diameter and was broken off about three feet from the lower end. With the ram lowered to the extreme limit the broken end was still between the tongs and only about twenty inches below the housing of the ram. At the upper limit of travel the broken end would be well up in the housing. This, therefore, eliminated the possibility of leaving any reinforcement at the point of the break.

These rams have been repaired in the past by other processes but in this case the writer was called in consultation to determine if it was not possible to use the arc process to make a saving in time and expense of performing the work and also produce a satisfactory job. After analyzing the problem we decided to undertake the job along the following lines.

A new tip for the ram was prepared from new steel stock leaving the upper end of the piece cut off flat on the end at right angles with the axis of the piece. The stub end of the ram was then beveled off from two sides to form a blunt chisel end, the point for starting the cut for each face being located above the end of the ram, a distance equal to the radius of the ram, namely five inches. Each face was cut parallel with a plane



Stripper Ram Was Repaired by Arc Welding at a Considerable Saving.

through both of the tongs so as to be easily available to the welder and not to have the tongs in the way.

The new tip was then secured in position and proper alignment with the ram obtained by means of two bolts on opposite sides of the pieces, these bolts passing through two clamps, one secured near the upper end of the tip and the other secured to the ram just above the beveled faces. These bolts were located adjacent to the tongs so as not to interfere with the welders.

This job was carried out during the cold weather, and, therefore, to make it possible for the welders to work continuously, a platform about eight feet square was constructed at the correct height under the ram so that the welders could easily reach the surfaces to be welded. A housing and roof was constructed around and over this platform to protect the work and welders from the wind and snow. A stove was also provided in the improvised house to keep the temperature sufficiently high so that the men could work with comfort, which is absolutely essential for good welding work.

This job was started at five p. m. and completed at seven-thirty p. m. the following day by two welders working straight through. Approximately one and one-half hours were lost due to power trouble and about two and one-half hours for meals. The total welding time was therefore about nine hours or eighteen man-hours. Approximately one hundred pounds of three-sixteenths inch diameter welding wire was used.

The alignment of the new tip with the main portion of the ram was almost perfect and after grinding off the excess weld metal the ram could be drawn up into the stripper boom without any binding. This alignment was easily maintained by having two welders work at the opposite sides at the same time depositing an equal amount of metal on each side.

The cost of carrying out this work was much less than by the former methods and the stripper was ready for service about twelve hours sooner, which is an important item.

The cost of repairing a ram even by the arc process shows only a slight saving over the cost of a new ram. However, the delay in obtaining a new ram would amount to several times this value due to keeping the stripper out of service.

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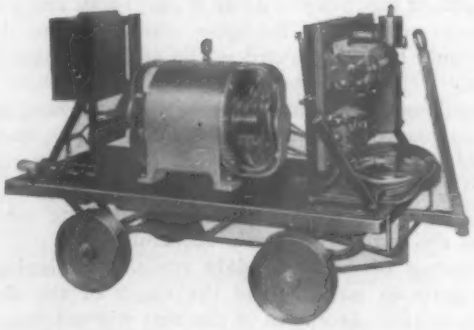

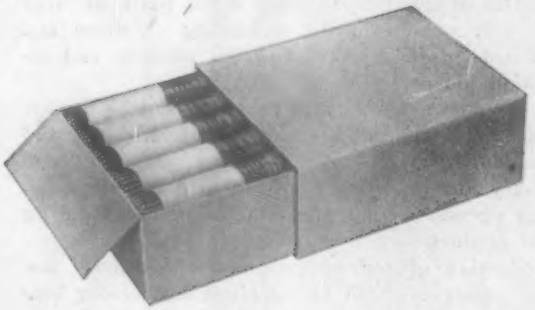

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PRODUCTION WELDING OF SHEET STEEL BY THE OXY-ACETYLENE PROCESS

(Continued from page 25)

require frequent replacement due to rough handling. These reasons account for the large number of manufacturers who are producing many thousands per day, each by a method peculiar to his plant and adapted to his machine equipment.

The successful production of sheet metal parts in large quantities is only possible when uniformity of shape and carefully planned jigs are provided which securely and accurately position the parts.

Jigs must be constructed so that the parts can be quickly placed and the finished product removed with despatch, and without distortion.

It is necessary that provision be made so that contraction and expansion stresses do not affect the accuracy of the jig or the welded product.

In the production of welded products which must line up accurately with and attach to machined surfaces or sections it is often essential to have the jigs adjustable within reasonable limits, and provision made for so holding the parts that when the contraction resulting from welding has taken place, the finished part will be true to the gauge. See Fig. 4.

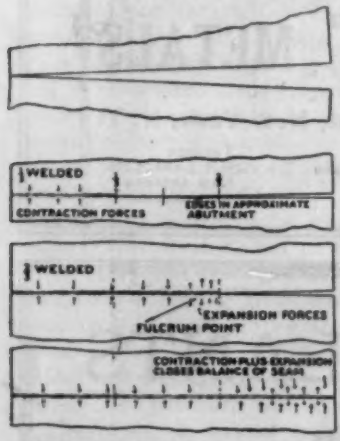

Figure 6—Welding Straight Sheared Edges in Sheet Metal.

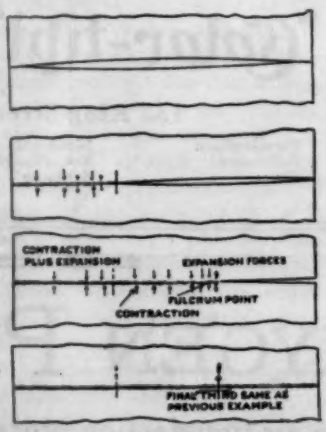

Figure 7—Welding Concave Sheared Edges in Sheet Metal.

An important point to be considered, and one which will often require several trials to determine, is the place where the welding must start and finish, in order that extreme accuracy may be attained.

Few welders acquire the same motions, or are capable of welding at the same speed, and this again must be carefully considered and watched in jig welding operations, requiring accuracy in the finished product. Unless welders employed on work of this kind are all trained by the same supervisor, and the procedure of welding operation planned and adhered to, it is necessary that each operator's jig be adjusted to his style and speed, and used by no other welder. The construction of jigs must be such that the clamping can be done quickly and with a uniform stress on the parts.

Distortion of the jig and parts must be avoided, unless the work is of such nature that distortion in a certain direction facilitates the welding operation, and counteracts a distortion which may be an after effect, due to the welding stress and the form of product.

The common form of welding jig for cylindrical work comprises a horn or anvil, properly shaped to hold the parts, and a clamp of a form which provides a V-shaped groove with a slot exposing the seam to be welded. There are certain operations which require the clamping of the edges separately, and in this case the clamp is divided so that the positioning of each arm can be a separate operation. See Fig. 5. This type of jig is often made so that the space between the clamping edges can be varied. Theoretically, this feature is essential for economical operation when parts of the same form and dimensions, but varying in thickness, are to be welded in the same jig. Heavier sheets require a greater spacing between the clamp edges. This is necessary in order that the flame may come in contact with sufficient surface of the sheet so that welding may proceed at an economical rate, and conducting losses into the jig be reduced to a minimum. It is necessary to provide a space in the horn or anvil directly below the seam, and when adjustability is provided in the upper clamping arms the same feature should be incorporated in the other for most efficient operation.

The depth of the V-shaped space is critical and must be planned so that the required clamping effect is secured and yet not of a depth which will interfere with the torch operation, or the vision. An excessive clamping effect is not only unnecessary, but has the effect of stressing the welded portion as the contraction strain accumulates.

As a matter of fact, the only reason for jigging is to hold the parts in position and the edges of the sheets in alignment, so that absorption of the heat will not cause buckles, or wrinkles, and to smooth out any which might be present in the part prior to welding.

A jig properly designed and adjusted will therefore permit the parts to move more or less freely with the influence of expansion and contraction, and at the same time prevent improper positioning from the afore-mentioned, or other causes.

The types and construction of jigs are as varied as the products produced in them. They are usually the result of gradual development and expansion of the process in the plants where they are found, most of them are ideally suited to the product made by their use.

Few, if any, hand welded operations require water-cooled jigs, and if used they detact from the speed and economy.

Manufacturers whose product is mainly sheet metal parts requiring steel from 15 to 12 gauge in thickness, and of a more or less cylindrical form, do not use jigs to any great extent, preferring to put the labor required for jigging into more accurate forming, and often by a simple tacking operation insure proper positioning of the edges, preparatory to welding.

There is always a doubt as to the wisdom and economy of this method, and it would seem certain that compared with similar operations carried out in jigs, the result would be in favor of the latter method.

Practically all hand welding operations require the addition of metal in the production of the welds. This is necessary because an operator cannot hold his torch with sufficient steadiness to insure neat work, and the addition of metal to the seam increases the thickness sufficiently, as that more latitude in torch operations is permitted, with the additional advantage of increased strength in the welded portion of the product.

Welders have their own pet methods of torch and welding rod manipulation, and while the elimination of lost motion, the use of the proper size of welding wire and welding tips would show economies, the results obtained are, as a rule, satisfactory.

As a matter of fact, it is far more important to use adding material of the proper quality, and control the mixture of gases accurately, than it is to prescribe the motions which shall be given the torch in weld production.

Many sheet metal products now being manufactured by the oxy-acetylene hand welding method, are being adapted to mechanical gas welding. In fact, it is becoming an actual necessity because the demand is increasing so rapidly that in some cases if this method were not adopted, additions

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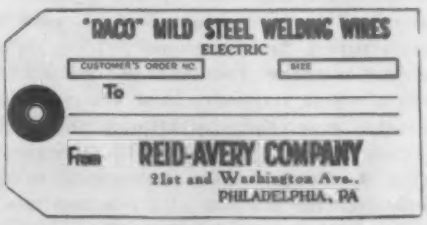

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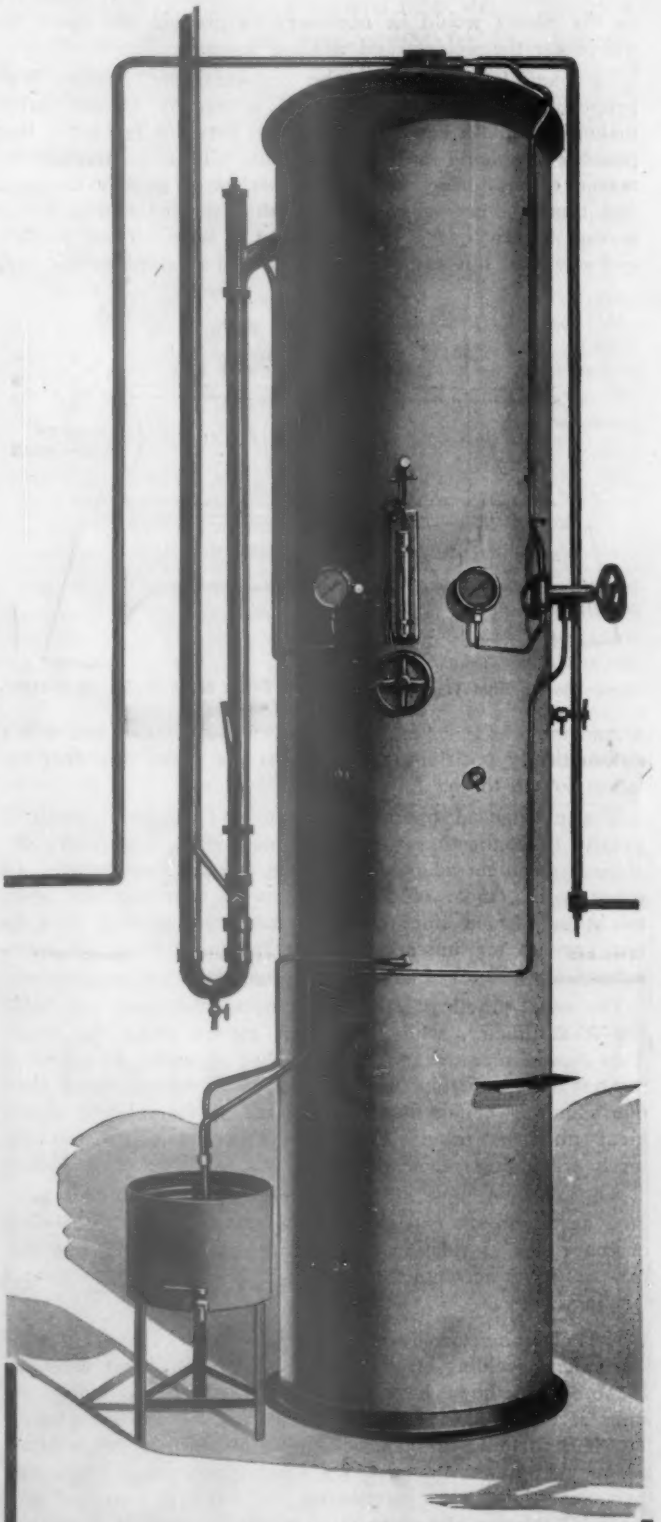

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to the plants would be necessary to provide the space required for the welders and welding stations.

Mechanical welding by the oxy-acetylene process with properly designed machines, and accurately formed parts, makes possible a production of from three to ten times that possible by hand welding methods. This is possible by reason of the ability to employ torches of greater capacity, and tips or burners having a multiplicity of flames which spread the heat over a greater length of seam. These torches and powerful tips can only be employed in combination with

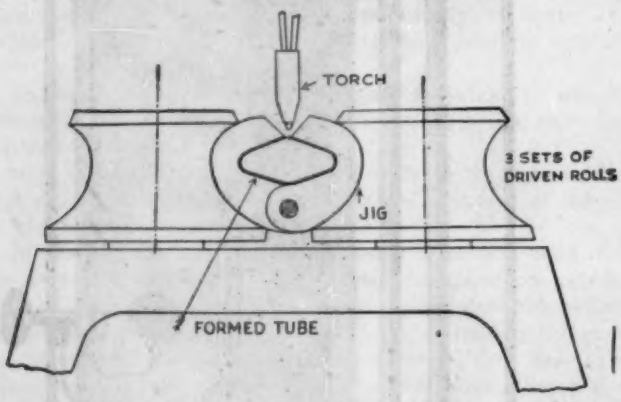

Figure 8—Machine Welding of Formed Tubes Held in Jig or Fixture.

a machine whose speed is under accurate control, and which automatically positions and presents the seam in proper relation to the torch.

The mechanical operation of the oxy-acetylene torch is usually in connection with some more or less specially designed machine adapted to some specific operation. In other words, most of the machines in operation are what might be termed single purpose machines, in that they do not provide for universal application in welding all sizes, gauges, and shapes of sheet metal products.

The usual practice is that of clamping the work and holding it stationary, while the torch moves along the seam. This is the more simple method, but in order to secure a reasonable production, it is necessary to employ more than one clamping or jig member, and means for relative movement must be provided between these members and the torch traversing mechanism.

A machine, or mechanism, properly designed, can be operated at maximum capacity by one man, if the positioning of the edges in relation to the torch is automatic, but this can only be accomplished through accurate shearing and forming.

The clamping or jigging principle differs very little in mechanical welding, from that employed in hand welding. Elaborate methods have been employed in particular instances, even to the extent of automatically positioning a flat sheet forming to shape, clamping in position and welding all in what might be termed a single operation. There are instances of intricate mechanism for torch motion and gas control automatically operated; in some cases in combination with the simplest type of work support and clamping mechanism. The idea back of all this is economy, but as a matter of fact excessive refinement in operation calls for extreme accuracy in preparation, and does not permit adjustments for the variables which are always present.

In the mechanical operation of the welding torch as applied to the welding of a long straight seam, there is presented a problem not present in hand welding operations. This is the problem of co-ordinating the rate of including the complete fusion of the edges, the expansion, and the resulting contraction.

Two methods are in vogue, one requires absolutely straight sheared edges, so that when the edges are placed together they will be in abutment throughout their entire length. For this method, the clamping or jigging mechanism must grip the metal firmly where the weld is to start, and with just sufficient pressure at other points to insure juxtaposition of the edges.

Assuming that the proper speed has been determined upon, and the correct adjustment of the gas and oxygen pressure made for this speed, it is then necessary to spread the edges apart at the finish of the weld, a distance which at this predetermined speed will permit the edges to move freely to and fro under the influence of the heat, and finally come together when the torch has almost completed the weld. See Fig. 6. The proper spacing of the edge when determined is controlled by a properly positioned gauge. The behavior of the edges during the welding operation under these conditions is quite uniform, and very interesting. For about one-third of the distance across the seam, the edges gradually move together and are practically in abutment, with only a very slight movement of the edges at the extreme end; as the torch progresses the edges now move together throughout the remaining length of the seam until the torch has traversed about two-thirds of the seam. Now, if the original spacing was correct, the edges will rapidly spread for an instant, and again come into gradual abutment as the torch completes its movement along the seam, resulting in a perfectly welded seam.

The other method requires less care and preparation, but is applicable only when extreme accuracy in dimensions is not required. It consists in shearing the edges of the sheet so that when formed and placed in position in the jig or clamping mechanism, the edges will be in abutment only at the extreme end, and the clamping effect should be uniform throughout the length of the seam. See Fig. 7.

With this method, the behavior of the edges is slightly different, in that they are brought into approximate abutment by reason of the expansion effect of the heat as the torch progresses along the seam, until about two-thirds of the seam has been welded, at which time the edges at the extreme end of the seam begin to open and again come together as the torch completes its travel, thereby producing a perfect welded seam.

A constant ratio of gap to length of seam may be utilized for all gauges within the range of the machine, and the expansion or closing effect compensated for by a change in the welding speed and gas consumption, or where a constant speed is maintained the gas consumption only may be changed.

The manufacturing and machine welding methods just described, do not have the production possibilities of machines in which the torch is stationary, and the work moves. In machines of this type, there is little if any time lost between the finish of one operation and the beginning of the next. See Fig. 8. Formed parts are mounted in jigs and the jigs moved through the machine at a constant rate, provision being made in some cases for automatically positioning the torch with reference to the seam in order to meet peculiar conditions.

Production by this method introduces the ability to produce welds which are a combination of fusion and compression. This is accomplished by the use of jigs which are more or less flexible, while in some cases the pressure is applied directly to the sheet metal part which is being welded.

There is no better known machine working on this principle, than the conventional Tube Welding Machine, of which there are approximately two hundred and fifty in daily operation in this country, producing over half a million feet of gas welded steel tubing in a nine hour day.

This type of machine construction lends itself readily to the utilization of jigs for holding tubular sections, which may be of round or other shapes, and of very short lengths.

Welds made under the influence of fusion and pressure have greater strength than hand welds of the same section or mechanical welds made by fusion only. Considerable attention is being given to this type of mechanical gas welding, and the adaption of many products to this method is at present under way.

Little, if any, effort has been put into the development of makin circumferential welds mechanically by the oxy-acetylene process.

This is not because it is impractical, but largely because manufacturers will not put the necessary effort into the production of parts sufficiently accurate for this type of welding operation. Then again it requires more complicated jigs and machines to successfully produce welds of this type. This is largely due to the fact that the positioning of the edges and the equalization of the stresses is more difficult.

The subject of oxy-acetylene welding in all its phases, is one worthy of attention of the most important officials in any company. The process is so simple, and its introduction into a plant so readily made, that the benefits to be derived from its most scientific application are often-times overlooked. Oxy-acetylene welding is not an incident in the manufacture of sheet metal products, it is more often the process which makes economical production possible, and should therefore be given the same consideration that is usually given to mechanical manufacturing methods.

The next few years will see great strides made in the application of gas welding, and particularly the automatic or mechanical application of the process. This is a natural and necessary development, and one which is being brought about by the demand for more and more production. The elimination of the human element, and the ability to depend with absolute assurance on a continuous production of uniform quality, with a minimum of supervision, is an accomplishment the attainment of which is worth all the thought and effort required.

News of the Welding Trade

In the announcement of the Ebright and Luthy Welding Shop which appeared in the July issue of *The Welding Engineer*, it was stated that Mr. Ebright has represented the K. G. Welding and Cutting Company in Chicago for several years. The information should also have been included that for the present Mr. Ebright will continue to take care of K. G. customers on sales and service as heretofore.

The new Detroit manager of The Burdett Oxygen Company is Mr. Harrison Bird who was recently with the Detroit office of The Air Reduction Sales Company.

Lorn Campbell, Jr., well known manufacturer of welding apparatus, and author of the popular Oxy-acetylene Welding Instruction Book is leaving the United States this month for an extended trip to Scotland. Mr. Lorn Campbell, Sr. is making the trip with him.

A four story and basement building at Ontario Street and Fairbanks Court, Chicago, was recently purchased by the Bastian-Blessing Company, manufacturers of Rego welding apparatus and will furnish increased facilities for manufacturing.

The Ohio Oxygen Company of Niles, Ohio, was recently admitted to the Gas Products Association as an active member.

A power plant 45x48 feet at East 103rd Street and Torrence Avenue, will soon be erected by the Chicago Steel and Wire Company of Chicago. In a recent announcement by President J. B. Green it was anticipated that the wire business of this company would continue to increase and plans are made to continue expanding plant facilities.

A Pittsburgh office has been opened by The Imperial Brass Manufacturing Company, Chicago manufacturers of oxy-acetylene welding and cutting material. Location of the new office is in the House Building, Pittsburgh, Pa. John A. Coyle and Elmer H. Miche are in charge.

The authorship of the article on tank welding which appeared in the July issue, should have been credited to Oxy-Acetylene Tips, the monthly publication of the Linde Air Products Company. In its original form this article contained a great many interesting and instructing photographs showing the welding of small tanks. Unfortunately space limitations did not permit reproducing the complete article.

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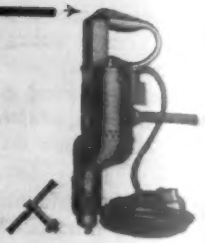

CURRENT WELDING LITERATURE

REGO WELDING AND CUTTING APPARATUS—REGO Catalogue No. 27, published by the Bastian-Blessing Company, Chicago. This is a handsomely printed fifty page booklet, giving complete details on REGO welding cutting, brazing, soldering, lead burning and carbon burning equipment. The inside front cover carries a chart in four colors, showing the different stages of welding flame adjustment. Several pages in the first part of the book are devoted to illustrated descriptions of different combination outfits, and telling for what purpose each outfit is designed. Two pages are given over to an illustrated discussion of parts involved in the design of their torches. Then follows illustrations and descriptions of each type of welding and cutting torch. The supplies and accessories listed, include goggles, preheating equipment, manifold, adapters, connections, etc. A special section is devoted to regulators, gauges and acetylene generators.

SMITHOGRAMS—A series of monthly bulletins issued by the Smiths Inventions, Inc., Minneapolis, Minn. Each bulletin contains a detailed description of a typical welding job. The numbers so far published deal with the following subjects. Welding a Fordson Tractor Wheel—Welding a Gas Engine Block—Making a Homemade V-Standard—Repairing a Broken Auto Frame—Making a Welding Table—Lead Burning.

METALLURGICAL ASPECTS OF WELDING, by Leslie H. Aitchison—A technical discussion of the points which interest the man who has to decide whether or not welding should be used in the building up of any particular piece of work. The paper deals with the normal structure of steel, and the changes in structure brought about by various methods of heating and cooling, and with the volume changes which take place as the steel is heated through different ranges of temperature—Acetylene Journal, August.

WELDING SMALL TANKS BY THE OXY-ACETYLENE PROCESS—How the Oxy-Acetylene Process has demonstrated its value for fabricating all types of small tanks.—The article is confined to the welding of tanks of not over 500 gallon capacity. Methods of figuring the dimensions and diagrams giving instruction for laying out and assembling, are included.—Acetylene Journal, August.

ARC WELDED CAST IRON ENAMEL WARE, by O. H. Escholz—Methods of repairing small holes in thin cast iron structures by the metallic electrode process. When cast iron electrode is used, local preheating is recommended and the electrode should be coated. Bare mild carbon steel electrodes have been used successfully for welding holes less than an inch in diameter. By controlling such factors as preheating temperature, electrode material and welding procedure, it is thought that considerable improvement can be made in this application of arc welding.—Journal A. W. S., July.

WELDING OF NON-FERROUS METALS, by C. J. Holslag.—Working instructions for welding thin iron plate, copper, aluminum, bronze, etc., with carbon arc. When thin sheets are to be welded, it is recommended that the edges be flanged, if possible. The arc is then run rather rapidly along the seam, melting the two vertical edges together into a single bead. If the plates are overlapped, the arc is held mostly on the upper plate. The advantage of using the double graphite electrode is that the flame can be pulled away from the work and the amount of heat supplied to the work lessened. This is a distinct advantage in welding very thin and delicate work.—Journal of the A. W. S., July.

WELDING BRONZE REQUIRES SPECIAL CARE TO INSURE SUCCESS, by Jack Norton.—90% Copper Bronze Rods are used where strength and resistance to corrosion are desired. 85% copper bronze is used for different parts of machinery, such as bearings, for contact with soft steel. 80% copper bronze is used for dies, bells, bearings, for contact with hard steel. The welding rod should contain the correct amount of tin and very slight traces of aluminum, and should be used only in the cast form. The selection of the flux is equally as important. The part to be welded should never project or overhang. Care must be taken not to allow the white cone to come into contact with the molten metal. Hammering is injurious to welded bronze.—Canadian Welding Journal, July.

ENGINEERS HAVE RECENTLY SOLVED MANY WELDING PROBLEMS, by C. E. Ziesel—A description of some welding problems which have been solved by welding engineers—the development of cast iron cutting—the improvement of welding procedure for tank construction and pipe line construction, and the selection of materials for better welded joints, are given as typical examples. —Canadian Welding Journal, July.

SAFETY IN WELDING PRACTICE, by C. F. Worfolk—The preventable accidents in welding are due to gas fires, gas explosions, tank explosion and valve explosions. Untrained, careless welders are the cause of the majority of accidents. Most of the personal injuries are either burns from hot metal, or injuries to the eye. These are easily prevented.—Canadian Welding Journal, July.

WELDING IRON ELECTRICALLY, by M. Lebrun—Use of gray iron electrode sufficiently high in silicon and capable of adding carbon to compensate for that burned away during fusion of the electrode in the arc. This addition of carbon is accomplished by surrounding the cast iron electrode with a covering containing a large percentage of graphite or charcoal. Before welding, the pieces are preheated to a temperature of 1300 degrees F.—Revue de Metallurgie, April.

APPLICATIONS OF AUTOGENE WELDING—A series of examples of the Applications of Oxy-Acetylene Welding to the fabricating the sheet metal products.—Revue De La Soudre Autogene, July.

OXY-ACETYLENE TIPS—Monthly publication of the Linde Air Products Company, July issue, contains the following articles—Saving time by Cutting Cast Iron—Valuable Bench Castings Salvaged from a Scrap Pile of a City Park—Production Welding of Pipe—Service which speeds the Going-Up Signal—Cutting Roll Housings—Reducing the Effects of Friction—Oxy-Acetylene Helps Maintain Yellow Cab—Selecting the Right Man for the Job.

ELECTRIC ARC WELDING APPLICATIONS—Repairing a Dynamo Yoke—Arc Welding in Boiler Work—Repairing a Broken Armature Shaft—Construction of a Transformer Tank—Replacing Teeth in a Pinion—Repair on Rolling Mill Wobbler—Repair Broken Crank Shaft.—Acetylene Welding Journal, July.

OXY-ACETYLENE CUTTING OF FORGED STEEL, by J. R. Dawson—Normalizing Cut Forgings—Cutting Red-Hot Steel—Treatment after Cutting. It would be more economical to cut steel while still hot from the forging operation than to allow it to cool and then reheat. All forgings should be normalized after cutting. A forging containing more than .45% carbon should be preheated before cutting.—Acetylene & Welding Journal, July.

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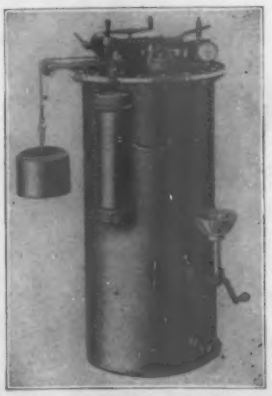

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18 E. 18th Street, Chicago, Ill.

Welding Carbon Products

Columbia Round Welding Carbons
Columbia Welding Carbon Plates
Columbia Welding Carbon Paste
Columbia Welding Carbon Flour

Our welding carbon products are designed especially for welding operations

National Carbon Company, Inc.
Cleveland, Ohio San Francisco, Cal.

CAST IRON RODS MADE FROM PIG IRON
(NO SCRAP USED)

Approximating
3.00%—in Silicon (Result: A soft weld)
.60%—in Phosphorus (Result: Fluidity)
.02%—in Sulphur (Result: A clean weld)

Our Rods the Best by Test. Also Rods, Wires and Fluxes for Welding All Other Metals

Prices on Application

Bierman-Everett Foundry Co.,
133-153 So. 20th St., Irvington, N. J.

OXYGEN
FOR CUTTING, WELDING, ETC.

Quick shipment and low prices on oxygen, hydrogen, cylinders, valves, Rego welding and cutting torches, regulators, welding wire, cast iron and aluminum rods, fluxes, plain and armored rubber hose, asbestos pads and paper, goggles, etc. All equipment fully guaranteed.

We are American pioneer manufacturers of oxygen. Write for catalog and prices.

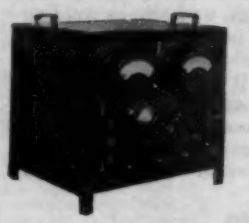
International Oxygen Company
Main Offices: NEWARK, N. J.
Branch Offices: New York, Pittsburgh, Toledo.

Specify—
"MOREY"

A Moisture Proof Aluminum Flux
Stable, Economical, Marvelous

MOREY FLUX & CHEMICAL CO.
Parkesburg, Penna. U. S. A.
Est. 1912 Inc. 1915

QUASI-ARC SYSTEM



We Manufacture:
A. C. & D. C. Welding Sets
Also Weldtrodes for
Mild Steel
High Carbon
Manganese
Cast Iron

L. W. 110 V. WELDER Gives Machinable Weld

QUASI-ARC WELDTRODE CO., INC.
Peekskill, New York

TYP E M6
½ H. P. MOTOR

Strand
Trade Mark

GRIND Those Welds With
STRAND
Flexible Shaft Grinders
Thousands in Use

N. A. Strand Co.
CHICAGO
5001-5009 North Lincoln St.

Westinghouse

manufactures complete arc welding equipment for all welding and cutting purposes. Write for Leaflet 1826-B which describes this equipment in detail.

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.

No. 511
Welder's Spectacle
Manufactured by
Chicago Eye Shield Co.
2300 Warren Ave. Chicago

IMPERIAL WELDING AND CUTTING EQUIPMENT
OXY-ACETYLENE PROCESS

A new mixing principle, a regulator that accurately controls gases, the greatest working range ever covered by ONE torch—are exclusive IMPERIAL features. Write for catalog.
Imperial Brass Mfg. Co., 817 S. Racine Ave., Chicago

DAVIS-BOURNONVILLE COMPANY
was merged with
AIR REDUCTION SALES COMPANY
on March 17, 1923

The Oxyacetylene Welding and Cutting products formerly manufactured by Davis-Bournonville Co. are now made and sold by Air Reduction Sales Co. under the trade name of "Airco-Davis-Bournonville" or "Airco-D-B."

(See advertisement of Air Reduction Sales Co.)

Carbic

"Carbicutting"

CARBIC CAKES

In the use of Carbic Cakes is hidden the secret of the success of the Carbic System. These solid, clean briquets that slide quickly and easily into the generator, permit an ease of handling, a convenience and a safety not otherwise obtainable.

For cutting, as for welding, the Carbic System of generating acetylene from Carbic Cakes contains unrivaled advantages.

The simplicity of generation, the cool, clean gas, the safety, the portability and the economy—all these, combined with many other features, give the Carbic System its well earned popularity.

There are hundreds of Carbic users in every section of the country. In all seasons of the year and under widely varying climatic conditions, Carbic is serving even the most exacting requirements of all classes of trade, from the small garage up to the largest steel plant.

Consider the Carbic System for your work. Write us today.

The Carbic System is complete, including generators, torches, regulators, hose and all other necessary apparatus and accessories.

Carbic Manufacturing Company

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141 Centre Street

DULUTH
General Office and Factory

CHICAGO
565 W. Washington Blvd.

BOSTON
27 School Street

ATLANTA, GA.
169 Haynes St.

CHARLOTTE, N. C.
W. 9th St. & So. Ry.

KANSAS CITY, MO.
1411 St. Louis Ave.

EL PASO, TEX.
412 Myrtle Ave.

DALLAS, TEX.
Briggs-Weaver

DENVER, COLO.
Hendrie & Bolthoff M. & S. Co.

NEW ORLEANS, LA.
Woodward, Wight & Co.

Warehouses and representatives in other principal cities.

We are also the exclusive manufacturers of Carbic Portable Lights.

TELEPHONE 165 W. D. BAUGH

GREENWOOD WELDING WORKS

PERFECT WELDING AND RAPID CUTTING OF ALL METALS

OXY-ACETYLENE AND ELECTRIC-ARC EQUIPMENT

GREENWOOD, MISS.

Aug. 1, 1923

Electric Arc Cutting & Welding Co.
Newark, N. J.

Gentlemen—

You are very kind: If I can help you sell a machine as suggested in your letter of Jul. 27, I reckon I might accept a donation, etc., and while the subject is up, why not bombard the ---------- Boiler & Machine Works of ----------, Miss. with your advertising and by the way they need an arc machine as badly or more so than the ---------- Machinery Co. Both concerns are responsible tho I want to tell you right here that it will probably be hard to overcome the propaganda put out by all acetylene supply men (Salesmen) about the glaring (?) faults of arc welding generally. It kept me out of the market for two years, and I only decided to buy when I saw your ad in the Welding Engineer that motor blocks could be welded on the car etc., and I bought it for that purpose alone, tho I am happy to say that my machine is handling at least 50% of the work I used to do with gas. And the cost is too little to add onto the price.

I am getting a very close price on oxygen, but this machine has decreased my gas consumption to the point where I fear my next contract will be much higher.

And in conclusion let me say that I am hoping and praying for a severe and sudden freeze this coming winter - - then watch me become a bloated capitalist overnight!

I am ready to help you sell if possible. It will not hurt me so badly, provided they do good work, as you know.

Yours truly,

(Signed) W. D. BAUGH

Doing good welding.

Facsimile of letter received this month by

ELECTRIC ARC CUTTING and WELDING COMPANY

152-158 Jeliff Ave. Newark, N. J.